PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

Edited and Issued Monthly by

THE INSTITUTION OF ELECTRICAL ENGINEERS

In Association with

THE PHYSICAL SOCIETY

THE AMERICAN PHYSICAL SOCIETY

THE AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS

ABSTRACTS 3649–4382

OLUME 52 **AUGUST 1949** NUMBER 620

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Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

MATHEMATICS 51

512.831

3649. On the classification of spherically symmetric matrices. SIBATA, T. *J. Sci. Hirosima Univ. Ser. A*, **12**, 255–67 (1943) *In Japanese.*—The definition of homogeneity suggested in an earlier paper [Abstr. 3752 (1949)] is investigated for microscopic phenomena. Application to the theory of the H atom is indicated. M. R.

512.94

3650. Use of complex vectors in the study of fields of alternating sinusoidal vectors. SARTORI, R. *Comment. Pont. Acad. Sci.*, **11** (*No.* 7) 241–72 (1947) *In Italian.*—Complex Cartesian vectors are defined and the algebra of these vectors is developed. The vector product of a complex vector and a real vector is considered. Sinusoidal vectors, with components.

$$a_x = A_x \sin(\omega t + \alpha_x), \ \ldots, \ a_z = A_z \sin(\omega t + \alpha_z)$$

are represented by means of complex vectors and some properties of this representation are deduced. L. S. G.

517.512.2

3651. Summation in finite terms of the most general Fourier series at every point outside the interval within which the series have been formed. VERNOTTE, P. *C.R. Acad. Sci., Paris*, **227**, 966–8 (*Nov.* 8, 1948) *In French.*—A Fourier expansion is given, in a series of terms each of which is determined by a root of a known transcendental equation, within a certain interval. The problem proposed is to evaluate the function represented by the Fourier expansion at points outside the specified interval. The method of solution employed, which depends on a certain condition being fulfilled by each term of the transcendental equation, is outlined in the present preliminary note, a more detailed account being reserved for a later communication. G. G.

517.564.3

3652. Bessel function expansions of certain Coulomb wave functions. ABRAMOWITZ, M. *J. Math. Phys.*, **27**, 157–8 (*July*, 1948).—The equation, $d^2y/d\rho^2 + \{1 - 2\eta\rho^{-1} - L(L+1)\rho^{-2}\}y = 0$, occurs in the problem of the motion of a particle in a Coulomb field of force. An expansion of the solution in terms of Bessel functions of integral order is given for the case $L = 0$. L. S. G.

517.9

3653. Some problems of numerical accuracy in the theory of differential and integral equations. ZEILON, N. *Lunds Univ. Arsskr.*, **43** (*No.* 10). *K. Fysiogr. Sällsk. Handl.*, **58** (*No.* 10) 30 *pp.* (1948) *In English.*—The 2 subjects discussed are: (1) the variational problem of the asymptotic phase and (2) the method of iteration in the theory of integral equations. In (2) the convergence and estimation of error is analysed. In (1) equations of the form $u'' + \rho(x)u = 0$, where $\rho(x) = k^2 + \rho_1(x)$, with $\rho_1(x) \to 0$ as $x \to \infty$, are considered. The solution for large x takes the form $A \sin(kx + \eta)$, and η is the asymptotic phase. The errors introduced in calculation of η by approx. methods are studied. The equations satisfied by the meson and deuteron are taken as examples. L. S. G.

517.94

3654. The solution by relaxation methods of ordinary differential equations. FOX, L. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 50–68 (1949).—The method is applicable to equations whose boundary conditions are specified at the 2 end points of the range of integration. The precision attainable can be accurately judged, and there is control over the error at all stages. The examples discussed include: (1) $y'' = 12x^2$, (2) $d^2(Bd^2y/dx^2)dx^2 = w$ where B and w are quadratic in x, (3) $d^3y/dx^3 = -yd^2y/dx^2 + \beta[(dy/dx)^2 - 1]$, this non-linear equation occurring in the theory of the boundary layer [Abstr. 2389 (1937)], (4) the eigenvalue equation, $y'' + \lambda y/x = 0$, with $y = 0$ at $x = 0$ and $x = 4$. L. S. G.

517.944

3655. The solution of some transient differential equations by means of Green's functions. WALTERS, A. G. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 69–80 (1949).—The equations solved are of the types $D(\phi) = c^{-1}\partial^2\phi/\partial t^2$, $D(\phi) = \kappa^{-1}\partial\phi/\partial t$, where D is a certain differential operator; they arise in vibrational problems and in problems on the conduction of heat. An example considered relates to the biharmonic equation,

$$(\partial^2/\partial r^2 + r^{-1}\partial/\partial r + \partial^2/\partial z^2)^2\phi + \lambda^2\phi = 0 \qquad (0 < r < \infty).$$

L. S. G.

517.946

3656. The triangulation of a two-dimensional continuum for the purpose of the approximate solution of second-order partial differential equations. TASNY-TSCHIASSNY, L. *J. Appl. Phys.*, **20**, 419–24 (*May*, 1949).—It is shown how a non-homogeneous, non-isotropic, electrically conductive, two-dimensional continuum can be replaced by a network of resistors whereby the nodes of the network are situated at any arbitrarily selected points, and how Southwell's relaxation method can be applied to this network for the solution of potential problems. A.

518.2

3657. A table of integrals involving the functions $E_n(x) = \int_1^\infty e^{-xu}u^{-n}du$. LECAINE, J. *Nat. Res. Coun. Can.* (*Publ. No.* 1553, 1948).—The functions $E_n(x)$ occur in the theory of diffusion. The integrands of the integrals tabulated are products involving: (1) powers of x and $E_n(\alpha x + \beta)$, (2) e^{kx}, x^m and $E_n(\alpha x + \beta)$, (3) $E_n(x)$ and $E_m(kx)$. Integrals involving $E_n(|x - x'|)$ are also evaluated. L. S. G.

518.3

3658. High precision nomogram. OSIDA, I. *J. Phys. Soc., Japan*, **3**, 25–9 (*Jan.–Feb.*, 1948) *In English.*—A method of rearranging nomograms in such a way as to reduce considerably the space occupied.

Alternatively, keeping the size constant, the scales used can be magnified and greater accuracy obtained.
N. L. J.

518.3

3659. Graph papers as instruments of calculation. BURROWS, W. H. *Amer. J. Phys.*, **17**, 114–26 (*March*, 1949).—The use of graph paper ruled in various ways to facilitate the evaluation of various types of formulae is described. Some simple nomograms are mentioned.
S. M.

518.42

3660. Gyrograms. FUCHS, H. O. *J. Appl. Phys.*, **19**, 796–7 (*Aug.*, 1948).—It is pointed out that the method described by Rojansky [Abstr. 1978 (1948)] can be used without modification to integrate equations of the more general type

$$m(d^2x/dt^2) + kx = f[t, x, (dx/dt)].$$

A. SCH.

518.5

3661. An electrical apparatus for the solution of systems of compatible linear algebraic equations. PROŠKO, V. M. *Trav. Inst. Math. Stekloff*, **20**, 117–28 (1947) *In Russian.*—Sets of 10 equations may be solved. The Gauss–Seidel iterative method is employed. For similar apparatus see Abstr. 1469 (1946).
M. R.

518.5 : 621.318.57

3662. An electro-integrator for the solution of ordinary linear differential equations with constant coefficients. KOROLKOV, N. V. AND KUMŹINOK, G. K. *Izv. Akad. Nauk, SSSR. Otdel. Tekh. Nauk* (*No.* 4) 517–32 (1948) *In Russian.*—The circuit uses directed quadripole amplifiers, allowing the simulation of any dynamical problem described by linear differential equations with const. coefficients. The speed of calculation depends only on the time constants of the circuit (of the order of a fraction of a second). The equations which may be solved are of the form $\sum_{k=1}^{n}(a_{ik} + b_{ik}\, d/dt)u_k = F_i(t)$, where $i = 1, \ldots, n$, the a_{ik} and b_{ik} are constants, and $F_i(t)$ are arbitrary functions.
M. R.

518.5

3663. A mechanical integraph for the numerical solution of integral equations. TEA, P. L. *J. Franklin Inst.*, **245**, 403–19 (*May*, 1948).—The results of an earlier paper [Abstr. 2218 (1946)] are used in the design of an integraph suitable for the solution of certain integral equations. The construction is described. Applications to the solution of equations of the Fredholm and Volterra types are considered.
A. H. W. B.

518.5

3664. A product integraph. JAEGER, J. C. AND CLARKE, J. D. *J. Sci. Instrum. Phys. Ind.*, **26**, 155–6 (*May*, 1949).—A description of a product integraph using 2 ball and disc integrators and built mainly from anti-aircraft predictor parts is given. Several applications of the machine are described.
A.

519 : 57

Development of mathematical biophysics in U.S.A. from 1939 to 1945 inclusive. *See Abstr.* 4359

519.2

3665. A method for producing a random sequence of numbers. TILLMAN, J. R., REYNOLDS, F. H. AND HILTON, P. J. *Phil. Mag.*, **39**, 807–20 (*Oct.*, 1948).—Physical phenomena in which randomness exists are briefly described, and in particular radioactivity is considered. To obtain a random series of digits in the scale of 10, it is sufficient to count the number of disintegrations occurring in successive intervals of time, each of short duration (e.g. $\frac{1}{7^1_5}$ sec). If successive counts were 37, 29, 41, 42, 39, . . . the digits 7, 9, 1, 2, 9, . . . would form the series. Practical difficulties of counting are overcome by using Ra in equilibrium with its products, so that a source of γ-rays results. The generation of each γ-ray means the occurrence of a discrete event and the rays are detected individually by a G-M counter. The experimental apparatus is described. It includes a random time pulse generator. The method eliminates the human element in the production of the sequence and increases the rate of production many times as compared with previous methods.
L. S. G.

519.2

3666. The restricted problem of the random walk. GORDON, A. N. *Phil. Mag.*, **39**, 572–5 (*July*, 1948).—A two-dimensional problem solved earlier [Abstr. 7 (1945)] is now solved by an alternative and improved method. The extension to 3 dimensions is made and the asymptotic solution, as the number of unit random steps increases, is obtained.
L. S. G.

519.27

3667. On the distribution of errors of measurement or observation in three-dimensional space. STANGE, K. *Z. angew. Math. Mech.*, **28**, 235–43 (*July–Aug.* 1948) *In German.*—It is assumed that each of the 3 co-ords. can be represented approx. as a linear function of R "fundamental" variables, mutually independent and each having a Gaussian distribution. The treatment is purely theoretical.
N. L. J.

519.27

3668. Error distributions bounded by a greatest [possible] error. GABRIEL, F. *Z. angew. Math. Mech.* **28**, 244–7 (*July–Aug.*, 1948) *In German.*—A formal analysis of the Jordan [Pearson Type II] distribution.
N. L. J.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.1

3669. On the problem of two bodies of variable mass, according to the Eddington–Jeans law. ROSSI, M. *Ann. Univ. Ferrara*, **4**, 279–87 (1943) *In Italian.*—The sum, m, of the masses of the two bodies varies with time according to the law, $dm/dt = -am^2$, where a is a positive constant. The results are (1) as $t \to \infty$, the number of revolutions of one body about the other increases without limit, (2) the perihelion is approx. stationary.
M. F.

521.1 : 621.385.16 : 537.533.3

Application of celestial mechanics to the theory of a magnetron. *See Abstr.* 4015

521.11 : 531.314.3

Some general properties of the equations of mechanics. *See Abstr.* 3772

521.13

3670. On the reduction of the three body problem. MUSEN, P. *Z. Naturforsch.*, **3a**, 360–3 (*June*, 1948) *In German.*—The transformation theory of Pfaff's expression is used to express the problem in terms of 8 co-ordinates. R. A. N.

521.37 : 530.12

Kepler and the Lorentz formulae. *See Abstr.* 3750

521.401.4

3671. A modification of the "variation of constants" method for special perturbations. HERRICK, S. *Publ. Astr. Soc. Pacif.*, **60**, 321–3 (*Oct.*, 1948).—A new selection of parameters is suggested for use in computations by electronic devices capable of handling complex sequences of mathematical operations. R. A. N.

523.11

3672. Cosmology. HECKMANN, O. *Himmelswelt*, **55** (*Nos* 1–2) 5–12 (1947) *In German.*—Complete text of the author's Hamburg Leibniz lecture in July, 1946, discussing critically the historical development of modern cosmology, the comparison of theory and observations and the problem of "world-models" and reality. The existing models are newly classified. A. B.

523.11

3673. Studies on the origin of the solar system. TER HAAR, D. *K. Danske Vidensk Selsk. Mat-fys. Medd.*, **25** (*No.* 3) 74 *pp.* (1948) *In English.*—The paper develops v. Weizsäcker's theory of the origin of the solar system [*Z. Astrophys.*, **22**, 319 (1944), Abstr. 1776 (1946)] and discusses some, though possibly not the most crucial aspects of that theory. A very brief review of other theories is also given. H. B.

523.11 : 530.12

Equations characterizing various Riemannian spaces treated in cosmologies. *See Abstr.* 3751

523.11 : 530.12

Improvement and supplement of the wave geometrical theory of the cosmos and nebulae. *See Abstr.* 3752

523.11 : 530.12

Comparison between the cosmology in wave geometry and the kinematical cosmology. *See Abstr.* 3753

523.112

3674. The steady-state theory of the expanding universe. BONDI, H. AND GOLD, T. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 3) 252–70 (1948).—The applicability of the laws of terrestrial physics to cosmology is examined critically. It is found that terrestrial physics can be used unambiguously only in a stationary homogeneous universe. Therefore a strict logical basis for cosmology exists only in such a universe. The implications of assuming these properties are investigated. Considerations of local thermodynamics show as clearly as astronomical observations that the universe must be expanding. Hence, there must be continuous creation of matter in space at a rate which is, however, far too low for direct observation. The observable properties of such an expanding stationary homogeneous universe are obtained, and all the observational tests are found to give good agreement. The physical properties of the creation process are considered in some detail, and the possible formulation of a field theory is critically discussed. A.

523.112 : 530.12

3675. On a spherically symmetric mass concentration in an expanding universe. QVIST, B. *Comment. Phys. Math., Helsingf.*, **13** (*No.* 11) 12 *pp.* (1948) *In English.*—Following Einstein and Strauss [Abstr. 374 (1946)], space is assumed to be empty in a sphere $r = r_0$ around a mass-particle, and the metric for $r > r_0$ is taken to be that of expanding space-time. A general integral of the field equations is obtained for $r < r_0$, and it is shown that the metric for this region may be determined if $p = 0$ for $r \geqslant r_0$. R. A. N.

523.112 : 530.12

3676. Some remarks concerning the connexion between two spherically symmetric relativistic metrics. KUSTAANHEIMO, P. *Comment. Phys. Math., Helsingf.*, **13** (*No.* 12) 8 *pp.* (1948) *In English.*—A general solution of the field equations is obtained for an isotropic metric in the case of a homogeneous mass distribution, certain assumptions being made concerning the form of the energy tensor. McVittie's metric [Abstr. 2819 (1933)] is obtained as a special case when the pressure is assumed to be isotropic. The case of zero pressure reproduces the metric discussed by Qvist [Abstr. 3675 (1949)]. R. A. N.

523.112 : 530.12

3677. A note on some general solutions of the Einstein field equations in a spherically symmetric world. KUSTAANHEIMO, P. AND QVIST, B. *Comment. Phys. Math., Helsingf.*, **13** (*No.* 16) 12 *pp.* (1948) *In English.*—It is assumed that there exists an isotropic co-ordinate system in which matter is at rest. The field equations are solved in terms of the solutions of an ordinary second order differential equation which is linear and homogeneous in the static case, and has the form $d^2y/dx^2 = y^2f(x)$ in the non-static case, $f(x)$ being an arbitrary function defining the nature of the metric. This latter equation is integrated for $f(x) = (ax^2 + bx + c)^{-5/2}$. Various well-known spherically symmetric metrics are shown to be special cases of the general solutions obtained. R. A. N.

523.25

3678. The disc theory of the origin of the solar system. BERLAGE, H. P. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 7) 796–806 (1948) *In English.*—Previous investigations [see Abstr. 498 (1948)] are reviewed and modified. When the disc condenses into rings, the radii will be expected to satisfy a relation corresponding to Bode's law. It is suggested that condensation proceeded inwards and outwards from Jupiter. R. A. N.

523.374.2

3679. On the determination of interstellar reddening at very great distances using RR Lyrae-stars. BECKER, W. *Himmelswelt*, **55** (*Nos* 3–4) 76–7 (1948) *In German.*—It is shown that all known RR Lyrae stars are, at light maximum, of very nearly the same spectral type, namely, *A*0–*A*3. An error of 1·5 in

their spectral classification corresponds to only 0·05 magnitudes in colour excess; and since these stars appear in all galactic latitudes and at all distances up to the limits of the galactic system, they should provide a new and powerful means to investigate the reddening in the distant interstellar space. A. B.

523.4

3680. The law of planetary and satellite distances. KUIPER, G. P. *Astrophys. J.*, **109**, 308–13 (*March*, 1949).—The stability of planetary or satellite orbits is shown to require that for 2 consecutive bodies whose mean mass (in terms of the mass of the primary body) is μ and whose relative distance is $\Delta = 2(a_2 - a_1)/(a_1 + a_2)$ (where a_1 and a_2 are the semi-major axes of the orbits), $\mu/\Delta^3 < 1$. The empirical relation $\log \mu = 2{\cdot}5 \log \Delta^3 - A$ is found to represent the facts within 10%. Consideration of the process of formation of a planet or satellite from a flattened disc in nearly circular motion leads to the relation $\mu/\Delta^3 \sim 10^{-2} - 10^{-1}$; the discrepancy between these relations is explained by incomplete condensation of protoplanet or protosatellite. Attention is called to the existence of 2 classes of satellites analogous to the classes "major" and "minor" of planets. M. W. O.

523.4 : 551.1

The constitution of the terrestrial planets. *See Abstr.* 4295

523.4 : 551.51

The atmospheres of earth and planets. *See Abstr.* 4298

523.41 : 523.42

3681. Visual photometry and colour of the planets Mercury and Venus. DANJON, A. *C.R. Acad. Sci., Paris*, **227**, 652–5 (*Oct.* 4, 1948) *In French.*—Describes a visual photometer enabling a reduced solar image to be compared with an enlarged image of either Mercury or Venus. Many determinations of the magnitude during the last 10 years permit the deduction of the variation with phase. Using red and green filters the colour indices have been determined and the results give Mercury and Venus similar values while for the moon the value is not greatly different. E. G. M.

523.5 : 621.396.99

3682. Radio Doppler investigation of meteoric heights and velocities. MANNING, L. A., VILLARD, O. G. AND PETERSON, A. M. *J. Appl. Phys*, **20**, 475–9 (*May*, 1949).—A continuous-wave Doppler method of determining meteoric velocities and heights was tested during the 1948 Perseid meteor shower. The accuracy of the technique was found to compare very favourably with optical and other radio methods. Doppler measurements have the advantage of relatively great sensitivity. A.

523.531 : 621.396.9

3683. Determination of meteor radiants for the daytime showers of 1948 May. CLEGG, J. A. *J. Brit. Astr. Ass.*, **58**, 271–9 (*Oct.*, 1948).—Describes a method of determining the position of meteor radiants by the use of a directional aerial working on a frequency of 72 Mc/s, and gives the results obtained. The positions in two co-ordinates of the radiants are given with an accuracy of 1½° and support those obtained a year ago. Useful references are given. E. G. M.

523.6

3684. On the motion and structure of comet tails. WURM, K. AND LEHMANN, W. *Himmelswelt*, **55** (*Nos* 1–2) 16–19 (1947) *In German.*—The authors examined all available material, several hundred plates, with a view to correlating clearly distinguishable single "rays" in the tail on different photographs. Only two pairs of plates proved suitable (comet Morehouse, 1908, and comet Brooks, 1911c.; the latter, with plates of 4 hours interval, allowed the identification of 12 single rays). The change in the directions of the rays was measured. Their widths remained unchanged and it is concluded that there does not exist general temperature motion of the molecules. A peculiar wavy character of the rays is emphasized, and a new comet-tail theory is indicated. A. B.

523.67

3685. Spectrum of comet Encke, 1947i. SWINGS, P. *Ann. Astrophys.*, **11** (*No.* 2) 124–36 (1948) *In French.*—McDonald spectrograms of this periodic comet, obtained in Oct., 1947, cover the region 3 000–6 700 Å, and show bands due to OH, NH, CN, CH_2, CH, CH^+, C_2 and NH_2. The spectrum does not differ in essentials from that of a non-periodic comet. The extension of the various bands in the head is considered in relation to the excitation processes and to the dimensions and distribution of the bodies composing it. The problem of the continual replenishment of the gases in periodic comets is discussed. A. HU.

523.72

3686. On a sensitive device for the measurement of smallest Zeeman effects in the solar spectrum. THIESSEN, G. *Himmelswelt*, **55** (*Nos* 1–2) 22–6 (1947) *In German.*—A contribution to the fundamental problems concerning the existence and magnitude of a general magnetic field of the sun. The author describes his new interferometric device whose application to the green Kr line 5 570 Å shows that it is possible to measure with certainty displacements of only 1/200 or even less of the observed line width. Observations in conjunction with the large Hamburg-Bergedorf refractor indicate the reality of a general solar magnetic field. The line Fe 6 173 Å (line width 0·2 Å, order of displacement 0·003 Å) gave in a preliminary way about 50 gauss for the pole. A. B.

523.72

3687. Some characteristics of solar radio emissions. HEY, J. S., PARSONS, S. J. AND PHILLIPS, J. W. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 5) 354–71 (1948).—An analysis is given of solar radio emissions, observed mainly at a wavelength of 4·1 m between March, 1946 and September, 1947, and their relation to visual solar phenomena and their geophysical accompaniments. The associations of solar radio bursts with flares are considered in detail and it is shown that the most intense flares are the most likely to produce radio bursts. It is also shown that in general the radio emission lags by several minutes behind the visual or u.v. flare radiations. The apparent tendency for coincidences between flares and bursts to be greater on the E than on the W half of the sun's disc is discussed. The distribution of coincidences with

respect to solar longitude from central meridian is contrasted with the sharply beamed pattern of continuous radiation associated with sunspots. A.

523.72

3688. Variations in solar radiation in the decimetre range. HOUTGAST, J. AND LAFFINEUR, M. *C.R. Acad. Sci., Paris*, **227**, 717–18 (*Oct.* 11, 1948) *In French.*—A trebling of solar noise at 550 Mc/s on Sept. 17, 1948, at 11.24 U.T. is related to visual observations of a solar flare of importance 2–3 starting at 11.22. The lag of 2 min is attributed to the time of passage of a corpuscular jet from the solar surface to the level of emission of the radio waves. A further series of disturbances on Oct. 4th is described. A. HU.

523.72 : 551.46

Note on eddy diffusion in the sea. *See Abstr.* 4297

523.73

3689. On the interpretation of the law of rotation of the sun's surface. BIERMANN, L. *Himmelswelt*, **55** (*Nos* 1–2) 29–30 (1947) *In German.*—The variation of rotational velocity on the sun, particularly its increase towards the equator, is investigated, using Bjerknes' theory of the atmosphere, based on the fact that meridional circulations of the sun's photosphere > 1 m/s appear to be absent. Agreement with the observations is found. A. B.

523.74

3690. Chromospheric flares. GIOVANELLI, R. G. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 2) 163–76 (1948).—A brief account of the observed properties of chromospheric flares is followed by a theory of their origin. This theory involves electric fields produced by variations in the magnetic flux through a nearby sunspot, as discussed in a previous paper [Abstr. 2451 (1946)]. If the electric field exceeds a certain value, then electrons acquire sufficient energy to excite H atoms at collisions, and flares may result. The theory shows that flares should occur in specific locations, which depend largely on the configuration of the magnetic field, in the neighbourhood of spot groups. The majority of the well-known features of flares, including their occurrence in the chromosphere, their stationary nature, their sudden beginning, and their correlation with the rate of growth of spots, are accounted for, and the theory also accounts for the amount of radiation emitted. A.

523.745

3691. A general study of a prominence field. DODSON, H. W. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 5) 383–97 (1948).—An attempt to find some order or pattern in the motions of knots in a prominence field and to view the prominence against the background of the general solar neighbourhood. It is based on the 9 moving knots of the prominence observed on September 16, 1947, which traversed similar, though not identical, trajectories, from a region high above a sunspot area to a point of attraction on the disc. Velocities of the knots increased from zero to more than 100 km/sec under accelerations which became as large as $\frac{1}{4}$ of solar gravity. Time-distance diagrams for the fast-moving knots are brought into coincidence for a large portion of the trajectory through arbitrary changes in the zero points from which the distances are measured. The similarity of these curves suggests that the velocity of the knots is a function of the distance, or time, from their starting-points, and that they form a system subject to the same force or forces. A.

523.75

3692. The relation between the solar spectrum of corona and chromosphere and the over-excitation in the chromosphere. WURM, K. *Himmelswelt*, **55** (*Nos* 3–4) 77–9 (1948) *In German.*—Discussion of the electron temps. and the suggested 3 causes of over-ionization and over-excitation in the chromosphere, i.e. increased penetrating ultraviolet radiation, energy of the probably present turbulence of the gases, electromagnetic processes. The author favours, mainly because of the spectral structure, the first one. A. B.

523.75 : 550.384.3

Geomagnetic "crochets" and solar data. *See Abstr.* 4290

523.752

3693. Characteristic properties of chromospheric flares. ELLISON, M. A. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1) 3–27 (1949).—Visual and photographic evidence over the last 9 years is summarized and compared with current theories of flare formation. Curves showing effective line-widths of Hα against time give a satisfactory basis for classifying flares and correlate well with their geophysical consequences. The high-velocity absorption filaments are identified with the larger limb surges. Line profiles of Hα show a great expansion of the wings (possibly due to Stark effect) when the central intensity surpasses 150% of the continuum, but there is no appreciable Doppler shift of the whole line. Asymmetry in the wings is attributed to absorption from the blue wing by atoms accelerated away from the surface near the time of peak intensity. These are tentatively identified with the aurora-generating particles before they have reached terminal velocity. A. HU.

523.77

3694. The coronal emission spectrum. WOOLLEY, R. V. D. R. AND ALLEN, C. W. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 3) 292–305 (1948).—The ionization in the corona is computed by supposing it to be determined by a balance between ionization by electron impacts and photoelectric recombinations. The results for an electron temp. of 10^6 deg agree with experiment. An estimate of the abundance of elements in the corona, from coronal line intensities in relation to the electron scatter continuum, gives a H to metal ratio of 6 000 : 1 by numbers. The collision excitation cross-section of Fe XIV 5 303 Å is found to be $0{\cdot}26\,\pi a_0^2$ by a method which does not assume the abundance of Fe XIV. The coronal emission in discrete lines, in bound-free continua, and in free-free continua, is separately computed. It is found that the principal lines of Mg X at 610 Å are strong in emission. It is suggested that the emission from the chromosphere in the Lyman continuum is stronger than the coronal emission, and the effects on the ionosphere of these spectra are briefly reviewed. A.

523.774

3695. Distribution of CN and CH bands across the sun's disk. PECKER, J.-C. AND PEYTURAUX, R. *Ann.*

Astrophys., **11** (*No.* 2) 90–106 (1948) *In French.*—The ratio of the centre-limb darkening in the continuum to that at the centre of a molecular band reaches a max. at a certain radius. This fact is related to the mode of production of the continuum and of the molecules and is in general independent of the distribution of the molecules in the solar atmosphere. A. HU.

523.774 : 535.331

3696. On an apparent change of wave-length in solar iron lines. EVERSHED, J. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 4) 347–51 (1948).—The telluric O lines in the solar spectrum have been used to test the stability of 4 solar Fe lines, 6 280, 6 297, 6 301 and 6 302, interspersed within the α group. In the interval of about 20 years the absolute wavelength of each of these lines photographed at the centre of the sun's disc appears to have decreased by measurable amounts. 6 280, representing a low level in the reversing layer, is the least affected, decreasing by only 0·002 Å, whilst the line 6 301 representing a relatively high level, has decreased by 0·008 Å. A table shows the various yearly values of wavelengths obtained, and the differences from the "Recommended" values of the I.A.U. At the sun's limb, the wavelengths of the 4 lines appear also to have diminished. The increase of wavelength at the limb compared with the centre spectra is tabulated, and this quantity for the lines 6 301 and 6 302 appears not to have changed materially from the earlier measures of Halm and Adams. A.

523.8

3697. The relationships between kinematic and physical properties of the stars. MICZAIKA, G. *Himmelswelt*, 55 (*Nos* 1–2) 63–7 (1948) *In German.*—Stellar-statistical investigation of the connections between absolute magnitudes, spectral types, character of light variations and stellar motions, and their importance for dynamical and cosmological problems. A. B.

523.82

3698. A bright region in Cepheus. RISLEY, A. M. *Astrophys. J.*, **109**, 314–20 (*March*, 1949).—Colour excess of early-type stars down to 11·5 mpg in a region in Cepheus show uneven space-reddening, with a mean total absorption of about 1·0 mpg/kpc. From data on stars of many spectral types, luminosity and density functions are developed, deviations from standard functions being discussed. M. W. O.

523.823

3699. Spatial abundance ratio of giants and dwarfs of spectral types *G*5 and *G*8. LOHMANN, W. *Z. Naturforsch.*, **3a**, 253–8 (*May*, 1948) *In German.*—The spectral classification of B.D. stars within 5° of the N. Pole is used to deduce relative numbers of giants and dwarfs of late *G* types, having regard to the effect of interstellar absorption. If the absorption rises linearly to 1·1 mag. at 450 parsec, the giant/dwarf ratio is 1 : 350 at *G*5 and 1 : 50 at *G*8. If the absorption is due to a cloud at 270 parsec, these ratios become 1 : 240 and 1 : 38 respectively. A. HU.

523.823 : 537.591.1

Magnetized stars as induction accelerators producing cosmic rays. *See Abstr.* 4065

523.83

3700. Some aspects of stellar evolution. IV. Th mean random velocity of the stars. EDGEWORTH K. E. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 5) 417–1 (1948).—It was suggested in a previous paper [Abstr 1985 (1948)] that the mean random velocity of th stars was originally much lower than it is now. Th present paper explains the subsequent increase o random velocity as being due to "viscous friction." The magnitude of the effect can be calculated, an leads to an estimate of the age of the Galaxy of abou 9×10^9 years, in good agreement with other simila estimates. A

523.84 : 538.11 : 530.

On the periodic magnetic field of certain stars. *Se Abstr.* 3745.

523.84

3701. Omicron Herculis. SCHMIDT, H. *Himmels welt*, **55** (*Nos* 1–2) 19–21 (1947) *In German.*—O account of a new reduction of 3 300 magnitud observations (1896–1940) of this interesting sta whose literature since 1870 led to discrepancies a to its possible variability, the author now consider the light as constant, certainly within 0·1 magnitudes A. I

523.841.3

3702. On the radiation of the Delta Cephei variable in the infra-red. BECKER, W. *Himmelswelt*, 5 (*Nos* 3–4) 75 (1948) *In German.*—Recent photo electric measurements by Hall and Bennett at 7 40 and 8 080 Å gave infrared amplitudes for the ligh variation of 3 Cepheids. The author uses the know colour temps. of these stars as they were observe between 4 800 and 6 350 Å, reduces them to radiatio temps., and obtains with Planck's formula th theoretically expected amplitudes. It is shown tha these radiation temperatures from the yellow an red region also represent very well the new infrare amplitudes. A.

523.841.3

3703. Pulsating stars and nuclear energy. STANLE JONES, D. Letter in *Nature, Lond.*, **162**, 934 (*Dec.* 1 1948).—Suggests that the rapid expansion is due to compression wave arising from nuclear fission in th interior; this is followed by gravitational contractio leading to a reconcentration of heavy nuclei. R. A.

523.841.37

3704. Pressure and temperature cycles in th reversing layers of Cepheid variables. ABBOTT, W. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1) 108–14 (1949 —Values of radius, mean density, surface gravit gas pressure and reversing-layer temperature a computed for all phases of variation of 5 Cepheid A pulsation of the reversing layer is revealed whic is out of phase with the pulsation of the photosphe A. H

523.841

3705. The masses and mass-ratios of close bina systems. STRUVE, O. *Ann. Astrophys.*, **11** (*No.* 117–23 (1948) *In English.*—Recent data for W UM systems, and for the fainter components of Algo-ty binaries, are summarized, and are found to involv considerable departures from the mass-luminosi relation. Discrepancies occurring in some ve massive systems are also discussed. R. A.

523.852

3706. Mechanical models of nebular clusters. LEMAÎTRE, G. *Bull. Acad. R. Belge. Cl. Sci.* **34** (*No.* 7) 551–65 (1948) *In French.*—A preliminary investigation in which the equations of motion are set up for a particle in a spherically symmetric mass distribution under the action of gravitation and cosmic repulsion. Space curvature and relativistic mass variation are neglected. Static models for uniform and infinitesimally condensed distributions are considered. Non-static models are to be considered later. R. A. N.

523.852.24

3707. Photometry of *NGC* 5128. EVANS, D. S. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1) 94–102 (1949). —Isophotes determined from calibrated plates in red and blue light are approx. circular and show a brightness variation close to an inverse square law. The object is probably a concentrated source hidden behind obscuring matter and surrounded by a shell of gas; it is unlikely to be extra-galactic. A. HU.

523.852.3

3708. The recession of the extra-galactic nebulae. DRUMAUX, P. *Comment. Pont. Acad. Sci.*, **11** (*No.* 12) 721–50 (1947) *In French.*—See Abstr. 1754, 3576 (1948).

523.852.3

3709. The recession of the extra-galactic nebulae. IV. DRUMAUX, P. *Ann. Soc. Sci., Brux.*, **63**, *Sér.* I (*No.* 1) 46–57 (1949) *In French.*—Previous papers [Abstr. 3576 (1948)] have considered motion relative to the galaxy; motion is now considered relative to the distant mass-systems implied by the theory. It is concluded that the galaxy moves with high velocity, and that nebular trajectories are approximately parallel. R. A. N.

523.852.31

3710. On the resolution of elliptic nebulae into stars. MÜLLER, H. *Himmelswelt*, **55** (*Nos* 3–4) 53–8 (1948) *In German.*—Critical account of recent work by Baade [Abstr. 821 (1944)] in the light of the Hertzsprung–Russell diagram for globular clusters. A. B.

523.855

3711. Star-streaming and the stability of spiral orbits in spiral nebulae. I. Motion round a point-nucleus. MILNE, E. A. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 4) 309–15 (1948).—It is shown that the spiral orbits determined in recent papers by the author [Abstr. 3031 (1947)] for motion round a galactic nucleus are stable. It is further shown that small deviations from these orbits give rise to the phenomenon of star-streaming, just as on Lindblad's theory. The velocity ellipse relative to a non-rotating frame is calculated in terms of the velocity ellipse relative to a rotating frame, following Lindblad and Smart, and it is shown that the two axes of the ellipse interchange themselves on passing from the latter ellipse to the former, as in the classical theory of gravitation. A.

523.855

3712. Star-streaming and the stability of spiral orbits in spiral nebulae. II. Motion in an extended distribution of matter. MILNE, E. A. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 4) 316–23 (1948).—The results of the previous paper are extended to the case where the gravitational field of the nebula is not merely that due to a point-nucleus. An appropriate expression is found for such a field, with the appropriate dependence on the time. Connection is made with well-known results of Lindblad and Oort. A.

523.87 : 523.852

3713. Forbidden spectral lines and the conditions for their appearance. WURM, K. *Himmelswelt*, **55** (*Nos* 1–2) 26–9 (1947) *In German.*—Critical discussion of Bowen's fundamental work on the spectra of the planetary nebulae [Abstr. 625 (1935)], and amplification of some of its statements. A. B.

523.872

3714. Colour temperatures of 146 stars. GAUZIT, J. AND PROISY, P. *Ann. Astrophys.*, **11** (*No.* 2) 137–56 (1948) *In French.*—Direct visual comparisons are made between the colours of stars and of the filament of a standard lamp, equalizing the colours by means of a device employing rotatory dispersion which absorbs selectively according to a λ^{-1} law. A probable error of $\pm 0{\cdot}35$ in C_2/T is deduced for a single determination at all spectral types. Mean temperatures of $17\,400° \pm 1\,000°$ for A0 stars and $4\,670° \pm 120°$ for K0 giants are in good agreement with photographic determinations. A. HU.

523.872

3715. The collisional excitation of the λ3727 radiation of O II. ALLER, L. H. *Publ. Astr. Soc. Pacif.*, **60**, 317–20 (*Oct.*, 1948).—Recomputation of the radiative transition probabilities for this pair of lines shows a target area for the collisional excitation of the ^2D state to be $\ll$ hitherto supposed. The abundance ratio of O to H in 5 gaseous nebulae is newly estimated to be $0{\cdot}0018$, a result $\gg$ that previously found but in agreement with the same ratio for the sun. A. HU.

523.872

3716. Analysis of the metallic-line stars. II. GREENSTEIN, J. L. *Astrophys. J.*, **109**, 121–38 (*Jan.*, 1949).—The high-dispersion analysis of τ UMa [Abstr. 2681 (1948)] is supplemented by lower-dispersion measures of Si, Al, Na, and the discussion of observed line intensities is continued. Metallic-line stars are related to *F* stars, and various physical mechanisms capable of accounting for the observed abundance deficiencies are discussed. R. A. N.

523.873

3717. Measures of the intensity jumps at the limit of the Balmer series in spectra of *B*-, *A*-, and *F*-type stars. MICZAIKA, G. *Z. Naturforsch.*, **3a**, 129–34 (*March*, 1948) *In German.*—Measures of the Balmer discontinuity in the spectra of 31 *A*-, *B*- and *F*-type stars are related to spectral type and absolute magnitude for giants, dwarfs, supergiants and bright-line stars. Results are compared with those of Barbier and Chalonge. D. L. E.

523.873

3718. Magnitude effects in *G*-type stars. GATHIER, P. J. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 5) 569–76 (1949) *In English.*—Equivalent widths have been measured for Ca I λ4227 and Sr II λ4077 in the spectra of 14 stars—supergiants, giants, dwarfs—with all about the same spectral type as the sun. The observed values are satisfactorily explained by the theory of

stellar atmospheres. The damping constant is found to be 5 to 10 times larger for dwarfs than for giants and supergiants. A.

523.875

3719. ζ Ophiuchi, an unusual *B*0 star. BECKER, U. *Z. Naturforsch.*, **3a**, 258–9 (*May*, 1948) *In German.*—Equivalent breadths in the spectrum of this star are used to estimate the surface gravity, the electron density and electron pressure, and the H and He abundances in its atmosphere. The electron pressure and surface gravity are unusually high for a main-sequence *B*0 star. A. HU.

523.877

3720. The chemical composition of stellar atmospheres. UNSÖLD, A. *Himmelswelt*, **55** (*Nos* 1–2) 12–16 (1947); (*Nos* 3–4) 59–63 (1948) *In German.*—Comprehensive critical account of recent progress in explaining the star spectra by introducing simplified models of the stellar atmospheres. Discussion of the new treatment of the intensity measurement of the Fraunhofer lines of the sun, curves of growth, turbulence, oscillator strengths, continuous absorption coefficients, etc. A table of the cosmical abundance of elements is derived from the author's own fundamental investigations on the sun and the star τ Scorpii, in comparison with the work of H. N. Russell and B. Strömgren on the sun and of Goldschmidt and Noddack on meteors. The internal agreement of all these NH-values, giving the total number of atoms present for the various elements, is most remarkable; e.g. the sun and τ Scorpii, which have astronomically nothing in common, are chemically almost identical, a fact of great cosmological importance. A. B.

523.877

3721. A composite giant star model with isothermal core. REIZ, A. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **25** (*No.* 1) 18 *pp.* (1948) *In English.*—A numerical method is used to investigate a model of Capella A with a non-productive core devoid of H. Sufficiently high temps. and densities exist next to the core for the C cycle to operate. For a H content between 0·31 and 0·32 a stable configuration results. A. HU.

523.877

3722. On an empirical relation giving the coefficient of central condensation for stars. CAILLIATTE, C. *Ann. Astrophys.*, **11** (*No.* 2) 77–89 (1948) *In French.*—The coefficient K is expressed in the form $C\rho^{\alpha}/\pi^{\beta}$, where ρ is the mean density and π the period of rotation. The constants C, α, β are evaluated from data for binaries possessing apsidal motion. R. A. N.

523.877

3723. Inward integration of the stellar equations. BONDI, C. M. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 4) 324–33 (1948).—A method of inward integration of the equations of stellar structure is applied and extended to cover the cases of radiation pressure and electron opacity. A.

523.877

3724. Radial oscillations of a particular stellar model. PRASAD, C. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 5) 414–16 (1948).—The radial oscillations of a stellar model having a point mass at the centre and constant density throughout the rest, have been considered. It is shown that an algebraic solution possible when the point mass is $\frac{1}{3}$ of the total mas of the star.

523.87

3725. Radial oscillations of a stellar mode PRASAD, C. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1 103–7 (1949).—Previous work [Abstr. 3724 (1949) is extended to a model with a continuous distributio of density without central singularity and vanishin at the surface. A solution is possible withou numerical integration, and the period and amplitud of radial adiabatic oscillations are found. The result are applied to δ Cephei. A. HU

523.87

3726. Abundance ratio of H and He in the atmo spheres of *O* stars. MICZAIKA, G. *Z. Naturforsch* **3a**, 250–1 (*April*, 1948) *In German.*—From observe equivalent breadths of λ4026 and λ4471 (He I) an of Hγ and Hδ in 21 *O*-type stars, the relativ abundances of H and He are derived. There is n dependence on luminosity or spectral class, and th mean abundance ratio is not greatly different from th value found in solar prominences. A. HU

523.87

3727. On the composition of stars of small masse SEN, N. R. AND BURMAN, U. R. *Proc. Nat. Inst. Sc India*, **14**, 271–7 (*May–June*, 1948).—In continuatio of a previous paper [Abstr. 2460 (1946)] on th internal constitution of stars of small masses, it i shown how the H and He contents of these stars ma be calculated from the observed values of their mas radius and luminosity, so as to be in complete agree ment with Bethe's energy generation law and othe mechanical and thermodynamical requirements fo equilibrium. It is found that in quite a large numbe of cases H constitutes about $\frac{1}{3}$ of the stellar materi while the He content fluctuates round an average o about 30%.

523.87

3728. New variational solutions of Milne's problem KOURGANOFF, V. AND MICHARD, R. *C.R. Acad. Sci Paris*, **227**, 1020–2 (*Nov.* 15, 1948) *In French.*—Se Abstr. 396, 432 (1949). The source function $B(\tau)$ i expanded in terms of the functions $K_n(\tau)$, the coeff being evaluated by a variational method similar t that used earlier [Abstr. 19 (1948)], but with integra tion replaced by summation over discrete values o the optical depth. The solution in which terms u to K_4 are retained is found to be more accurate tha approx. solutions obtained by other methods. R. A. N

523.87

3729. Variable guillotine factor models for late typ main sequence stars. WILLIAMSON, R. E. AND DUF G. F. D. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1 46–54 (1949).—5 point-source models of red dwarf are integrated, radiation pressure being neglected with guillotine factors varying with the followin powers of the density: 0·375, 0·50, 0·55, 0·60 an 0·625. The method of application to any give chemical composition and opacity theory is indicated A. HU

523.87

3730. On the role of the guillotine factor in deter mining the structure of late type main sequence star WILLIAMSON, R. E. AND DUFF, G. F. D. *Mon. No*

Roy. Astr. Soc., **109** (*No.* 1) 55–61 (1949).—The equations connecting the H and He content of a star with its luminosity, mass and radius are developed for an opacity following Kramers' law corrected by a guillotine factor varying with an arbitrary power of the density. Thence an iteration procedure is used to deduce the chemical composition of *Kr* 60 *A*, o_2 Erid *C* and Castor C_2 on the basis of the models computed previously [Abstr. 3729 (1949)]. No entirely satisfactory fit is possible, and further progress awaits a more fully developed representation of the guillotine factor. A. HU.

523.877

3731. The integration of the equations of stellar structure. BONDI, C. M. AND BONDI, H. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1) 62–85 (1949).—A new method of integration is described in which variables that are homology-invariant are introduced and made non-dimensional by the use of the appropriate physical constants. The variables chosen depend only on the equations of mass conservation and of hydrostatic support, not on the energy transport equation. Much of the instability met with in other methods is transferred from the differential equations to the simple quadratures connecting the new variables with the familiar physical ones. Reduction in the order of the problem by one enables the onset of instabilities to be detected easily and renders accurate integration unnecessary; graphical working is thus appropriate. General graphs are illustrated by which the method can be applied to every spherically symmetrical steady or quasi-steady model. A. HU.

523.877

3732. A thermodynamic consideration in relation to acoustic energy in stellar models. GOLD, T. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1) 115–16 (1949).—Since acoustic energy is thermodynamically "free" energy, any thermal process liberating noise is subject to the thermodynamic limitations of a heat engine. A recent model of red giant stars [Abstr. 1668 (1949)] in which internal energy transport is entirely in the form of noise cannot therefore exist, nor is acoustic energy ever likely to play a major part in outward energy transport. A. HU.

523.877

3733. Anharmonic pulsations of the standard model. SCHWARZSCHILD, M. AND SAVEDOFF, M. P. *Astrophys. J.*, **109**, 298–302 (*March*, 1949).—Rosseland's theory is applied, the computation being extended to 2 terms in the development of the displacement. For Cepheid amplitudes, skewness is found to be appreciable but less than that observed. The calculated periods differ only slightly from those of harmonic pulsations. R. A. N.

523.877

3734. The structure of degenerate stellar configurations near the limiting mass. REIZ, A. *Astrophys. J.*, **109**, 303–7 (*March*, 1949).—Boundary quantities and physical characteristics of white dwarf configurations are computed by a perturbation method for $1/y_0^2 < 0{\cdot}01$, y_0 being the parameter occurring in Chandrasekhar's differential equation. R. A. N.

526.15/.17 : 551.11

3735. The figures of the earth and moon (third paper). JEFFREYS, H. *Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **5**, 219–47 (*July*, 1948).—The paper consists of a general adjustment of the data relevant to the radius and ellipticity of the earth, the lunar parallax and the differences of the moments of inertia of the moon. The anomalies of gravity recently found to persist over distances of 10° and 30° imply similar anomalies in the deflection of the vertical and provide a means of estimating the additional uncertainty that they introduce. When this is taken into account it is found that the data are satisfactorily consistent. Attempts are made to find additional checks on the existence of the anomalies of gravity represented by harmonics of degrees 2 and 3 other than the main ellipticity term, but they are indecisive, and the final solution is a compromise between solutions with and without them. The chief changes from current values are a reduction of the earth's equatorial radius from 6 371·388 km to 6 371·099 ± 0·116 km (s.e.) and the value of g at Potsdam from 981·274 gal to 981·2606 ± 0·0010 gal; owing to recent work by the Anglo-Iranian Oil Company the British stations are now strongly connected with the new determination of the absolute value of g at Teddington. The change in the equatorial radius is due to the use of free-air instead of isostatic reductions; reasons are given why the latter may have introduced a systematic error. A.

526.15/.17 : 551.11

3736. The figure of the earth. JEFFREYS, H. *Nature, Lond.*, **162**, 915–17 (*Dec.* 11, 1948).—The external gravitational field of the earth can be found if the geopotential at sea level is determined. This can be obtained from observed values of gravity (g_1) provided the variation with height (h) is known. If $g_1 = \alpha + \beta h$, the constants α and β can be found by least squares and hence the mean value of g_1 and its uncertainty. No other method, such as isostatic reduction, is free from systematic error. Over 10° and 30° squares considerable variations of β were found, and the mean free air anomalies also showed larger irregularities than could be explained from the apparent uncertainties. There is a strong correlation at stations up to 10° apart and an appreciable one up to 30°. Values at adjacent stations cannot therefore be treated as independent. Analysis shows that 4 spherical harmonics of degrees 2 and 3 have apparently significant amplitudes. These are used to estimate the uncertainty in the deflection of the vertical at the end of a geodetic arc, and hence the accuracy with which the earth's radius may be determined. The absolute values of gravity at Potsdam, Teddington and Washington are recomputed. The following revised estimates of terrestrial and lunar constants are given: Earth's radius (a) = 6 378·099 ± 0·116 km; ellipticity (e) = 1/297·10 ± 0·36; gravity at sea level (g) = $978{\cdot}0373\{1 \pm 0{\cdot}0000024\}\{(0{\cdot}0052891 \pm 0{\cdot}0000041)\sin^2\phi - (0{\cdot}0000059)\sin^2 2\phi\}$; lunar parallax = 3 422·419 ± 0·024; mass of earth/mass of moon = 81·278 ± 0·025; precessional constant = 0·00327260 ± 0·00000069 B. C. B.

526.7 : 550.312

3737. Attempts to replace the elastic comparison force in gravimeters by capillary or electrostatic forces. ISING, G. *Ark. Mat. Astr. Fys.*, **36 B**, *Paper* 7, 8 *pp.* (1948) *In English.*—A preliminary report on research work done since 1937 to overcome the difficulties in

gravity measurements caused by temp. variations and elastic creep. The elastic counter-force usually obtained either by a spring or compressed air was replaced by capillarity or by electrostatic repulsion. For the instrument based on capillarity an improved type has been developed with a mean error of 0·5 mgal on solid ground and of 3 mgal on a ship in motion. With the electrostatic type measurement is made in a vacuum of 4 mm Hg and a characteristic feature is a cascade insulation of the electroscope system. Results were promising although further experimental work is required to overcome thermal disturbances. R. N.

PHYSICS 53

53

3738. Recent trends in American physical science. Overbeck, C. J. *J. Sci. Instrum. Phys. Ind.*, **26**, 1–12 (*Jan.*, 1949).

53.07 + 542.2

3739. Laboratory and workshop notes. *London, Edward Arnold and Co.*, 1949, *pp.* xii + 272, 195 *illustrations.*—Notes compiled from the *J. Sci. Instrum.* over the last 25 years. Chapters: Lab. and workshop tools, processes and devices. Clamps, supports and agitators. Soldering, brazing and welding. Glass manipulation and silvering. Vacuum and pressure technique and devices. Electrical and magnetic devices and techniques. Optical devices and techniques. Devices for liquids and gases.

53.081.1 : 621.3.081.1

3740. Systems of electrical units in lectures on experimental physics. Wolf, F. *Optik*, **3** (*Nos* 1–2) 81–98 (1948) *In German.*—Engineering students, who are familiar with the international system of electrical units, are confused by the introduction of absolute systems into lectures on experimental physics. The author holds that the relations between the various systems are not satisfactorily explained in the standard text-books, and this paper outlines the method he has adopted in the Karlsruhe Technische Hochschule to correlate the international system used in engineering with an absolute system which is suitable for the discussion of electric vector fields. The basic quantities are the metre, kilogramme, second and coulomb, from which the laws of the electrostatics are developed; these are followed by the definition of current, the principles of magnetostatics and the laws of electromagnetism. The connection between the systems is clearly displayed and the author claims that it removes much of the difficulty he has found in teaching physics to technical students. B. H.

53.088.21

3741. Errors in scale estimation. Eastwood, E. *Research, Lond.*, **1**, 575–6 (*Sept.*, 1948).—Phenomena similar to Abstr. 816 (1948) are reported.

53.088.22

3742. Errors of second-order measuring instruments. Benedikt, E. T. *Rev. Sci. Instrum.*, **20**, 229–33 (*April*, 1949).—The various types of error which affect the result of a measurement performed by an instrument behaving as a second-order linear instrument are defined. The theoretical systematic error is shown to be caused by the (dynamical) lag with which the instrument responds to the signal. If the damping is high, this type of error is $\propto$ the rate of change of the signal. The accidental error resulting from input noise and accidental changes of the instrument constants is considered. It is shown that all these effects can be represented by an effective input noise. A formula for the mean square error in the indication of the instrument is given in terms of the correlation function of the above effective noise. Related theoretical questions on random functions are also discussed. A.

FUNDAMENTALS 530.1

530.1 : 538.1

3743. Rotation and magnetism. Reulos, R. *C.R. Acad. Sci., Paris*, **227**, 1433–4 (*May* 3, 1948) *In French.*—Describes an electrical apparatus that would illustrate an analogy between a magnetic field and an inertial field relative to a rotating frame [see *Cah. de Phys.* (*Nos* 31–2) 84 (1948)]. R. A. N.

530.1 : 538.1

3744. Magnetism of celestial bodies and gravitation. Mariani, J. Letter in *Nature, Lond.*, **162**, 612–13 (*Oct.* 16, 1948).—The total energy of an isolated spherical mass of liquid is considered, and an additional term is found to arise on account of the difference between Euclidean and non-Euclidean volumes. This additional energy is identified with that arising from an assumed partial separation of electric charge, and the resulting charge is found to be given by Wilson's formula $\sigma = \rho\sqrt{G}$; there will also be a surface charge of density $\propto G^{3/2}$. R. A. N.

530.1 : 538.11 : 523.8

3745. On the periodic magnetic field of certain stars. Gião, A. *C.R. Acad. Sci., Paris*, **226**, 2126–7 (*June* 28, 1948) *In French.*—The result "magnetic moment = $kG\times$angular momentum" has been derived from static solutions in the author's unitary theory [Abstr. 3046 (1947)]. It is now shown that Babcock's observation [Abstr. 3292 (1949)] may be covered by the theory by setting up a non-static solution in which the constant k becomes replaced by a periodic function of time. R. A. N.

530.1

3746. What is the geometry of a plane in rotation? Blanuša, D. *Hrvatsko Prirodoslovno Drustvo Glasnik Mat.-Fiz. Astr., Ser. II*, **1**, 97–111 (1946) *In Croatian* (*French Summary*).—The line element on the disc is $d\sigma^2 = d\rho^2 + \rho^2(1 - \rho^2\omega^2/c^2)^{-1}d\psi^2$, where ω is the angular velocity and (ρ, ψ) are cylindrical co-ordinates. The circumference of a disc of radius ρ is thus $> 2\pi\rho$. For small ρ the geometry of the disc is approx. Lobachevskian. M. R.

530.1

3747. The theory of Birkhoff. Hély, J. *Rev. Sci. Paris*, **86**, 115–20 (*Jan.* 15, 1948) *In French.*—A review

of the theory of Birkhoff [Abstr. 839 (1945)] and of Birkhoff and Barajas [Abstr. 488 (1945)]. The theory of gravitation is firstly considered and then the unification of gravitation and electromagnetism is discussed. Alternate methods of unification are referred to, and a remark is made about the expanding universe. L. S. G.

530.12

3748. A classical analogue of the relativistic time dilation. VON KLITZING, K. H. *Z. Naturforsch.*, **3a**, 176–9 (*March*, 1948) *In German.*—Following Heaviside's method of establishing the Fitzgerald contraction of a moving observer by the use of classical electrodynamics, the Lorentz–Einstein time dilation and the transverse Doppler shift are similarly established by purely classical arguments. The limitations of the physical significance of these results are discussed. H. B.

530.12

3749. On the regularity of gravitational and electromagnetic fields in unitary theories. THIRY, Y. *C.R. Acad. Sci., Paris*, **226**, 1881–2 (*June* 7, 1948) *In French.*—The discussion is concerned with the author's treatment of 5-dimensional relativity in *C.R. Acad. Sci., Paris*, **226**, 216–18 (1948). R. A. N.

530.12 : 521.37

3750. Kepler and the Lorentz formulae. KOWALEWSKI, G. *C.R. Acad. Sci., Paris*, **227**, 762–3 (*Oct.* 18, 1948) *In French.*—Equations relating the true and eccentric anomalies in a planetary orbit are used to define a group of projective transformations. The group is shown to include the Lorentz transformations of special relativity. R. A. N.

530.12 : 523.11

3751. Equations characterizing various Riemannian spaces treated in cosmologies. TAKENO, H. *J. Sci. Hirosima Univ., Ser. A*, **12**, 125–36 (1942) *In Japanese.*—It is shown that spherically symmetrical solutions of certain tensor equations must be one of several familiar types. The space-times are classified according to the eigenvalues of a certain matrix. M. R.

530.12 : 523.11

3752. Improvement and supplement of the wave geometrical theory of the cosmos and nebulae. SIBATA, T. *J. Sci. Hirosima Univ., Ser. A*, **12**, 137–40 (1942) *In Japanese.*—The theory of the cosmos in wave geometry is criticized and some improvements are made. M. R.

530.12 : 523.11

3753. Comparison between the cosmology in terms of wave geometry and the kinematical cosmology from the standpoint of the momentum-density vectors. TAKENO, H. *J. Sci. Hirosima Univ., Ser. A*, **13**, 327–30 (1944) *In Japanese.*—It is shown that the momentum-density vector in wave geometry is partly of Milne's type and partly of Einstein's type. Differences between the cosmology in terms of wave geometry and that of Milne are discussed. M. R.

530.12 : 523.11

3754. A new model for the expanding universe. HOYLE, F. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 5) 372–82 (1948).—By introducing continuous creation of matter into the field equations of general relativity a stationary universe showing expansion properties is obtained without recourse to a cosmical constant. A.

530.12 : 523.112

On a spherically symmetric mass concentration in an expanding universe. *See Abstr.* 3675

530.12 : 523.112

Two spherically symmetric relativistic metrics. *See Abstr.* 3676

530.12 : 523.112

A note on some general solutions of the Einstein field equations in a spherically symmetric world. *See Abstr.* 3677

530.12 : 531.51

3755. On the Riemannian curvature tensor. I. Einstein's theory. II. Eddington's and Schrödinger's theory. JORDAN, P. *Z. Phys.*, **124** (*Nos* 7–12) 602–13 (1948) *In German.*—Certain general properties of covariant differentiation are obtained by a method involving the use of locally geodesic co-ordinate systems; the method leads to a simplified discussion of the properties of the curvature tensor. In II, some general properties of differentiation are used to provide an axiomatic definition of affine differentiation, and the properties of the curvature tensor are again investigated. R. A. N.

530.12 : 531.51 : 538.3

3756. Electromagnetism and relativity. III (cont.)–IV. MARIANI, J. *Cah. de Phys.* (*No.* 33) 31–62 (*Oct.*, 1948) *In French.*—[See Abstr. 2695 (1948)]. The development of a unified theory is continued. In order to obtain a geometrical representation of the electromagnetic field, the structure of space-time is generalized by introducing a torsion as well as a metric. It is not possible to obtain field equations directly in terms of the contracted curvature tensor B_{ij} in generalized space-time as this tensor is not uniquely determined, but the equations are obtained in terms of a tensor A_{ij} which is a linear combination of tensors such that the undetermined components cancel. The principal axes of A_{ij} are indeterminate. The new field equations reduce to the usual gravitational and electromagnetic equations *in vacuo*. In the presence of matter the usual equations also follow if the ratio of the proper charge density σ to the proper mass density ρ is regarded as a universal constant. The results will be generalized to cover variable σ/ρ in a later publication. R. A. N.

530.145

3757. On the fundamental axioms of quantum mechanics. CASTOLDI, L. *Riv. Nuovo Cim.*, **4** (*No.* 1) 90–100 (1948) *In Italian.*—The theory is built up on a basis of 3 postulates. The third concerns systems having a classical analogy. L. S. G.

530.145

3758. On the unification of the representations of the theory of a particle of maximum spin $2(h/2)$. PÉTIAU, G. *Cah. de Phys.* (*No.* 33) 1–16 (*Oct.*, 1948) *In French.*—The general equations of particles of high spin obtained by combining Dirac equations can be unified by the introduction of a 5th co-ordinate x_5 with suitable extra terms in the Hamiltonian. The reduction of the equations in 4 dimensions gives equations for a particle of max. spin 1, or for a particle of max. spin $\frac{1}{2}$. This unification can also be achieved by introducing a fifth co-ordinate canonically

conjugate to the mass. This second formalism also results in new limitations on the interaction constants between particles of max. spin 1 and those of max. spin ½. G. J. K.

530.145

3759. Quantum mechanics as a statistical theory. MOYAL, J. E. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 99–124 (1949).—In this important paper a new approach to the theory of quantum mechanics is presented, the subject being interpreted as a form of statistical dynamics. The distribution functions of the complete set of dynamical variables specifying a system, i.e. phase-space distributions, are expressed in terms of the wave vectors of quantum theory, and an interpretation of quantum kinematics is thus obtained. The laws governing the transformation of the distributions are obtained from the equations of motion of quantum dynamics and are of the proper form for a dynamical stochastic process. These transformation equations are available as an alternative to the Schrödinger equation in the solution of problems such as the evolution of wave packets, collision problems and the calculation of transition probabilities. Quantum statistics is developed. This deals with the phase-space distribution of members of large assemblies, and possible applications to kinetic theories of matter are discussed. Practical applications of the theory are considered very briefly. L. S. G.

530.145

3760. On the self-energies and cross-sections of orthodox quantum mechanics. GREEN, H. S. *Proc. Roy. Soc. A*, **197**, 73–89 (*May* 11, 1949).—Several novel techniques are introduced having as their objects, first, the gain of a new understanding of the divergence difficulties of orthodox quantum theory, and secondly, the systematic development of the quantum mechanics of fields in terms of the density matrix. There is included a new presentation of a form of perturbation theory which has the outstanding advantages over the usual one that it is much more quickly convergent, and leaves the density matrix normalized at every stage so that the diagonal elements representing occupational probabilities cannot diverge. Exact general formulae are derived for self-energies and cross-sections for the purpose of examining their convergence properties. The general theory of fields is developed *ab initio*, and it is shown that the use of the density matrix in place of the wave vector illuminates and simplifies the customary theory. The second quantization of the density matrix which follows throws unexpected light on the existence of particles with negative expectation values. Finally, the whole theory is applied to the crucial example of the electron or positron in an electromagnetic field. It is confirmed that the self-energy of the electron in the orthodox theory cannot be made finite without the introduction of negative energy photons. A.

530.145 : 530.12

3761. Relativistic Hamiltonian system of a particle and relativistic Heisenberg's equation. TZOU, K. H. *Phil. Mag.*, **39**, 790–9 (*Oct.*, 1948).—A new system of relativistic Hamiltonian equations is set up. This is suggested by the classical equations. The relativistic form of Heisenberg's equation follows from this system. This equation is applied to Dirac's theor of the electron. The velocity-vector operator i obtained and Einstein's mass-energy relation i deduced. The law of conservation of total angula momentum is related to the spin tensor. L. S. C

530.145 : 537.12

3762. On the problem of the self-energy of th electron in the theory of Gustafson. SERPE, J *Physica, 's Grav.*, **14**, 223–36 (*May*, 1948) *In French.*— In Gustafson's theory the effects due to retardatio were neglected [Abstr. 1729 (1947)]. A more exac calculation is now made, taking these effects int account. The method differs from that of Nilsso [Abstr. 2335 (1948)], but the results agree with his Only a single electron is considered. L. S. C

530.145 : 537.12

The calculation of the self-energy of the electron *See Abstr.* 3967

530.145 : 538.

3763. Negative energies in generalised electro dynamics. RAYSKI, J. Letter in *Phys. Rev.*, **74**, 62 (*Sept.* 1, 1948).—The procedure used by Podolsky an Schwed [Abstr. 2010 (1948)] to avoid negative energie in their generalized electrodynamics is shown to b erroneous. G. J. K

530.145 : 538.

3764. Quantum electrodynamics. I. A covarian formulation. SCHWINGER, J. *Phys. Rev.*, **74**, 1439–6 (*Nov.* 15, 1948).—The first of a series attempting t discover whether at moderate energies the know divergences of quantum electrodynamics can b isolated as unobservable quantities, which can b regarded as renormalization constants. E.g. whethe the recently observed deviations from the Dira electron theory can be accounted for unambiguously without new concepts or appreciable modifications o the theory. Thus it is shown that the e.m. proper mass of the electron merely produces a renormaliza tion of the electron mass with no observable conse quences other than a conflict with the actual finitenes of the observed mass. This paper describes a com pletely covariant formulation with respect to Lorent and gauge transformations which is essential in theory with divergences, owing to the ambiguitie which may arise in the cancelling of infinities. Th usual canonical commutation relations between th fields at 2 points on the 4-dim. plane t = const. ar expressed covariantly, using a many-time formalism where they apply between any 2 points on any space like surface. A covariant electrodynamics is the constructed in the Heisenberg representation. Fo practical purposes neither this nor the Schrodinge representation is satisfactory, since commutator between points separated by a time-like interval ca be constructed only by solving the equations o motion, and so a canonical transformation is mad that changes the Heisenberg equations into those o non-interacting fields, and therefore describes th coupling between fields in terms of a varying stat vector. In this mixed representation, which is calle the interaction representation, and is based on th distinction between the properties of non-interactin fields and the coupling between them, it is simple t evaluate commutators between arbitrary space-tim points. A discussion of the covariant elimination o

the longitudinal field is then given, in which the usual distinction between longitudinal and transverse fields is replaced by a suitable covariant one. Finally a description of collision processes is given in terms of an invariant collision operator, which is the unitary operator that determines the overall change in state of a system as the result of interaction. It is shown that the collision operator is simply related to the Hermitian reaction operator, for which a variational principle is constructed. A.

530.145 : 539.18

3765. The perturbation method in the theory of quantised fields and the construction of the Heisenberg *S*-matrix. PIRENNE, J. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 226–32 (1948) *In French.*—By the radiation damping theory which suppresses divergent terms an integral equation can be obtained for a function K which determines the S-matrix [Abstr. 2331 (1948)]. For mesons of finite mass scattered by nucleons treated as extended sources a similar procedure can be found assuming that these extra terms are finite. In the Schrödinger equation for scattering allowance is made for the change ΔE due to the nucleon in the self-energy of the field, i.e. of the incident and scattered mesons. For a heavy nucleus, all ΔE are equal and the equation for K can be solved by a perturbation method on the assumption that K contains no singularities. This method also determines successive approx. to the ΔE. G. J. K.

530.145 : 539.18

3766. On the wave equation of a particle of maximum total spin ($h/2\pi$) possessing several mass states. PETIAU, G. *J. Phys. Radium* (*Sér.* 8) **9**, 245–8 (*July–Aug.–Sept.*, 1948) *In French.*—A method of van Isaker which allows different mass values to appear in the different irreducible representations of the same matrix meson equation is introduced into the particle equations in 5 dimensions. After imposing auxiliary conditions corresponding to the fifth co-ordinate the irreducible representations correspond to a Møller–Rosenfeld vector-pseudoscalar meson of mass m_1, a scalar meson of mass m_2, a vector and a pseudo-vector meson of mass m_3 and m_4. The electric charge can also be introduced so as to have different values. G. J. K.

530.145 : 539.18

3767. On some properties of particles of spin $\frac{1}{2}$ in electromagnetic fields. PETIAU, G. *J. Phys. Radium* (*Sér.* 8) **9**, 218–24 (*June*, 1948) *In French.*—The Dirac equation of the electron is examined in detail when the electromagnetic interaction is not only through the potentials (ϕ, A), but also the fields (E, H), which implies an intrinsic magnetic moment not due to the charge. The various results, including the decomposition of the force on the particle, are also obtained in non-relativistic approximation. G. J. K.

530.145.6

3768. Calculation of the potential from the asymptotic phase. II. FRÖBERG, C.-E. *Ark. Mat. Astr. Fys.*, **36 A**, *Paper* 11, 55 *pp.* (1948) *In English.*—A procedure is obtained, simpler than that given earlier [Abstr. 1771 (1948)] for the calculation of the potential by successive approximations. This can be generalized [cf. Abstr. 2725 (1948)]. It is now easier to calculate the second approximation and results are given for the gauss, meson and square well potentials. From a discussion of the convergence of the method it is claimed to be satisfactory if the potential is weaker than r^{-2} at the origin and vanishes faster than r^{-1} at ∞, but no definite proof is given. Concluding sections deal with the calculation of phases from cross-sections, and the evaluation of certain integrals, which are mostly generalizations of Dirichlet's discontinuous factor. G. J. K.

530.145.6

3769. Operators of the first and second order. The role of the Hermitian in their determination. The Hamiltonian in the case of an electromagnetic field. The first integral of the first order. The physical significance of measurable quantities associated with integrals of the first order and the second order. FAURE, R. *C.R. Acad. Sci., Paris*, **227**, 670–3 (*Oct.* 4, 1948) *In French.*

530.145.6 : 539.18

3770. On the interaction between vector mesons and nucleons. OZAKI, S. *Progr. Theor. Phys.*, **1**, 56–69 (*Aug.–Sept.*, 1946) *In English.*—With a momentum cut-off to give the correct scattering of mesons by nuclei the correct anomalous magnetic neutron or proton moments are obtained for an intermediate value of the coupling constant (which is not explicitly given). G. J. K.

530.145.63

3771. Erratum: On the application of Heisenberg's theory of *S*-matrix to the problems of resonance scattering and reactions in nuclear physics. HU, N. *Phys. Rev.*, **75**, 1449 (*May* 1, 1949).—See Abstr. 2723 (1948).

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.314.3 : 521.11

3772. Some general properties of the equations of mechanics. MINEUR, H. *Bull. Astr., Paris*, **13** (*No.* 4) 309–28 (1948) *In French.*—General solutions are obtained for systems whose Hamiltonians H may be expressed as a function of k integrals in involution; the solutions are expressed in terms of those for k generalized equations. Systems for which H is defined by an equation of the form $F(H, t, q, p) = 0$ are also discussed. R. A. N.

531.36

3773. On the dynamics of solids. MELCHIOR, P. *Bull. Acad. R. Belg. Cl. Sci.*, **34** (*No.* 5) 445–8 (1948) *In French.*—A method is given whereby Euler's equations can be obtained without introducing the usual angles ϕ, θ, ψ. The motion of the solid is defined by the motion of a trihedron, fixed in the solid, and with origin at the centre of gravity of the solid. Kinetic energy and potential energy are expressed in the co-ordinates defining the position of the moving trihedron. Hence are derived Lagrange's and Euler's equations. G. G.

531.43

3774. The forces of static and kinetic friction. SCHNURMANN, R. *An. Acad. Brasil. Ciênc.*, **20**

(*No.* 2) 197–210 (1948) *In English.*—The relation of friction force to average relative velocity of two surfaces in contact, and the mechanical and electrical actions taking place which account for friction, are discussed with reference to experimental results. An electrostatic theory is advanced to explain the mechanism of motion by jerks, and supporting measurements are recorded. The value of the coefficient of static friction for given materials is proved to depend on the condition of the surfaces in contact, that is, on the presence of films of adsorbed or condensed matter. Its value is small when for a large normal load the materials composing the separating film exhibit low shear strength: it is large for surfaces with exceedingly thin separating films and a very small ratio between load and shear strength for the materials in contact. Complementary to the discussion of the mechanism of friction the relation of the force of friction to temp. is reviewed, and it is shown that a temp. coefficient of energy dissipated by friction and a temp. coefficient of the angle of slip can be experimentally determined. G. G.

531.51

3775. The gravitational field of a rotating nearly spherical body. CLARK, G. L. *Phil. Mag.*, **39**, 747–78 (*Oct.*, 1948).—For previous work see Abstr. 189 (1941). The gravitational equations are solved and solutions for the external and internal fields are obtained. The energy tensor in the interior is determined. It consists of a part representing the mass motion and a part representing the internal stresses which vanish at the boundary. Solutions for some special simple systems (e.g. rotating sphere) are given. L. S. G.

531.51

3776. On the gravitational mass of a system of particles. CLARK, G. L. *Proc. Roy. Soc. Edinb. A*, **62** (*Pt IV*) 412–23 (1949).—In classical mechanics the mass of a system of gravitating particles can be defined to be the mass of an equivalent particle which gives the same field at great distances, or alternatively the mass can be defined by means of Gauss' theorem. Reference to the former procedure was made by Eddington and Clark [Abstr. 2724 (1938)] in a discussion on the problem of n bodies. The relativistic extension of Gauss' theorem has been investigated by Whittaker [Abstr. 1996 (1935)] for a particular form of the line-element and for more general fields by Ruse [*Proc. Edinb. Math. Soc.*, **4**, 144 (1935)]. The latter, treating the problem from a purely geometrical point of view, expressed the integral of the normal component of the gravitational force as the sum of two volume integrals. The physical significance of one of these integrals was quite obvious, but the meaning of the other was far from clear. In this paper the terms in Ruse's result are examined as far as the order m^2 in the case of a fundamental observer at rest and the 1938 discussion modified to bring the two investigations into line. It is concluded that the surface integral of the normal component of the gravitational force taken over an infinite sphere is $-4\pi\times$ the energy of the system. A.

531.51

3777. The equivalence of the gravitational and invariant mass of an isolated body at rest. CLARK, G. L. *Proc. Roy. Soc. Edinb. A*, **62** (*Pt IV*) 424– (1949).

531.5

3778. The internal and external fields of a partic in a gravitational field. CLARK, G. L. *Proc. Roy. So Edinb. A*, **62** (*Pt IV*) 427–33 (1949).—The gravitationa field of a system of particles was investigated b de Sitter as far back as 1916 [*Mon. Not. Roy. Ast Soc.*, **77**, 155–84 (1916)]. A minor alteration to th analysis was made by Eddington and Clark in 193 [Abstr. 2724 (1938)]. The amended value of th potential g_{44} is the same as that derived by Einstei Infeld and Hoffmann without making use of th energy-tensor; this agreement suggests that the revise de Sitter argument is correct. In this paper it shown that this is not the case, for the de Sitte analysis completely overlooked any possible inte action terms in the stress components of the energ tensor. The value of these terms, p_{mn}, is shown an it is found that the agreement mentioned above is du to the fact that the volume integral of p_{ll} vanishes.

531.571 : 536.4

3779. On the burning of powder. PEKKARINEN, I *Comment. Phys. Math. Helsingf.*, **13** (*No.* 10) 114 *p* (1947) *In German.*—Three propellants were fired i closed and vented vessels and the variation of pressu p with time t was observed. The main constituen were nitrocellulose (11·8% N) and nitroglycerine the following percentages: NC 56 NG 33; NC 5 NG 36; NC 51 NG 45. The remaining constituen were coolants and stabilizers. Closed vessel firin showed that the burning rate of these propellants a linear function of the pressure over the rang investigated (approx. 100–2 000 kg/cm²). The effe of charge temp. and moisture-content was examine It was found that $\Delta I/I = -3{\cdot}1\%$, $\Delta f/f = +0{\cdot}3\%$ per 10°C rise, $\Delta I/I = +8{\cdot}8\%$, $\Delta f/f = -1{\cdot}3\%$ p 1% moisture-content where I is the value in close vessel firings of the integral $\int p dt$ between limi $p = 0$ and $p = p_{max}$, and f is the force of the pr pellant. A method is developed for estimating th pressure-time variation in a rocket. Vented vess firings at high pressures confirm the accuracy of th method, using rates of burning deduced from close vessel work. Low pressure firings indicate that at suc pressures the rate of burning is appreciably great than would be obtained by downward extrapolatio of the linear law which holds at high pressure A formula is derived for the determination of he losses to the walls of a rocket combustion chamber A. SC

MECHANICAL MEASUREMENTS 531.7

531.717 : 778.3

3780. On a method for measuring the thickness thin coating films by means of X-ray reflex photograph REGLER, F. *Elektrotech. u. Maschinenb.* [*EuM*] 6 109–13 (*July–Aug.*); 148–52 (*Sept.–Oct.*, 1948) *German.*—The general fundamentals of X-ray refle photography and some known methods for th measurement of film thicknesses are discussed.

new method is described for measuring the thickness of a film deposited on a crystalline base. It utilizes the difference of absorption of X-rays diffracted by the base under different glancing angles. The measurement is preferably made by photometric evaluation of pictures taken with a conical or ring-film reflex system. The photometric method may be replaced by ionometric intensity measurement. Disturbances caused by the coincidence of lines, by a coarse grain structure or irregularities in the lattice structure of the base, may be overcome by special experimental means which are described in detail. R. N.

531.717.8 : 535.312

3781. Testing of polished or fine ground surfaces for flatness. ELLIOTT, A. *J. Sci. Instrum. Phys. Ind.*, **26**, 24 (*Jan.*, 1949).—The testing of nearly flat surfaces by the astigmatism produced in a light beam reflected from the surface is discussed. The use of the test for ground surfaces is described, and attention is drawn to its use in the working of soft materials such as rock salt. A.

531.724 : 541.183.26

Studies of metal surfaces by low-temperature gas adsorption. *See Abstr.* 4234

531.76

3782. A novel recording accelerometer. IBERALL, A. S. *Rev. Sci. Instrum.*, **20**, 304–7 (*April*, 1949).—The novel features of a small recording accelerometer of slow chart speed are described. Principally, these are its compactness—the recorder, less power supply, fits into a panel type aircraft instrument case—and the use of spark recording to obtain a visible record on a paper chart. Components selected to achieve compactness are a timing type synchronous motor to drive the chart; a 35 mm film cartridge to store the chart, and a model aeroplane spark coil to provide a high voltage repetitive spark. A simple preliminary chemical treatment for ordinary paper was developed to obtain an intensified trace on the record chart. Small or panel type recorders of other physical quantities can be similarly built, applying the main features of this design. A.

531.765

3783. Measurement of short time intervals by spark chronographs. WOEHL, W. *Arch. tech. Messen Issue No.* 160 (*V*142–10) *T*16–17 (*March*, 1949) *In German.*—The principles of measurement of short intervals in the range 100 ms to 1 μs are discussed. Systems employing purely electrical, electro-mechanical, and electro-optical methods of recording are described, and possible methods of spark production for recording processes are discussed. A table of the mean quadratic errors observed in measuring a given time interval with these various methods is given, and methods of reducing the errors are outlined. F. LL. J.

MECHANICS OF FLUIDS 532

532.13 : 536.4.031

3784. Supercooled sulphur and its viscosity. FANELLI, R. *J. Amer. Chem. Soc.*, **67**, 1832–4 (*Oct.*, 1948).—Liquid S can be cooled in bulk to approximately 50° and in droplets to room temp. without it undergoing any essential change in nature from that in which it exists in the range 115–160°. Values of the viscosity from 50° to 155° are given and discussed; values below 80° have been extrapolated. W. R. A.

532.13

3785. Effect of concentration on the viscosity of dilute solutions. SIMHA, R. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 409–18 (*April*, 1949).—A theory of the higher coefficients of the viscosity-concentration curve of a suspension of non-spherical particles is presented. Starting with the simple model of a dumb-bell, the flow around a single particle and its modification due to interaction with other particles are considered. It is shown that the coefficients a_i in the equation $\eta = \eta_0(1 + a_1c + a_2c^2 + a_3c^3 + \ldots)$ are related to each other, namely, $a_2 = k_1a_1^2$, $a_3 = k_2a_1^3 \ldots$, where the k's are independent of molecular size, in agreement with empirical equations. An explicit value for k_1 is obtained that applies also to models consisting of various arrays of spheres. The variation of k_1 with molecular shape is discussed, and various factors affecting the numerical values and the validity of the last-mentioned equation are pointed out. A.

532.13 : 537.36

3786. Electroviscosity. III. Sedimentation phenomena in ionic liquids. ELTON, G. A. H. *Proc. Roy. Soc. A*, **197**, 568–72 (*July* 7, 1949).—It is demonstrated that the rate of sedimentation of a system of particles in an ionic liquid may vary markedly with the ionic concentration, due to variation in the electroviscous forces which resist shear in the double layer of ions associated with each particle. Equations governing the rate of sedimentation are derived, and used to calculate values for the electrokinetic potentials of carborundum in KCl solutions, from data on sedimentation velocity. These values are compared with those previously obtained from data on electro-endosmosis. [See Abstr. 2364, 2365 (1948)]. A.

532.133

3787. Viscosity of pure liquids. Influence of temperature and constitution. LUCATU, E. *Bull. Soc. Roumaine Phys.*, **42** (*No.* 78) 105–28 (1941) *In French.*—Temp. dependence of viscosity has been investigated by calculating the ratio of viscosities, at a series of temps., for 2 liquids having the same volatility, shown by equal boiling points. A long molecule liquid is used as comparison, and spherical molecules show an abnormal decrease of viscosity with increase of temp. The variation for alcohols and organic acids is parallel to the degree of association, as judged by the absorption of the OH band at 9 622 Å. A bibliography of 84 references is appended. E. H. D.

532.133

3788. On a molecular theory of viscosity of solutions with small molecules. STUART, H. A. *Z. Naturforsch.*, **3a**, 196–204 (*April*, 1948) *In German.*—A molecular theory of the internal friction of solutions has been developed for the purpose of giving a better explanation of the specific viscosity η_{sp} of diluted solutions. η_{sp} is defined by means of the "mutual action viscosity" η_{12} which consists of 2 factors one of which contains the local density, while the other measures the

intensity of the momentum exchange between the solute and solvent molecules. The negative viscosity values and their occasional increase with temp. are completely inexplicable in the light of thermodynamical theory, whereas the molecular theory gives an easy explanation. The paper furnishes a method for examining the molecular structure of liquids and solutions, since it becomes possible to study the different possibilities of association by measuring the change in specific viscosity with temp. and concentration. The molecular model has also been adapted for solutions containing thread-like molecules. F. L.

532.133 : 541.18

Theory of viscosity of colloids. *See Abstr.* 4224

532.5 : 539.374

3789. The hydrodynamics of non-Newtonian fluids. II. RIVLIN, R. S. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 88–91 (1949).—The theory of a previous paper [Abstr. 1781 (1948)] is applied to the problem of the flow through a tube of circular cross-section. Abs. values of the normal stress components are not uniform over a cross-section of the tube, but the pressure difference between points at equal radii on 2 such cross-sections is independent of the positions of the points. L. S. G.

532.51

3790. On the flow of a perfect fluid between two plates from a circular inlet channel. BENEDIKT, E. T. *J. Appl. Phys.*, **19**, 1094–5 (*Nov.*, 1948).—The following problem is discussed mathematically: a perfect incompressible fluid is supplied, through a circular orifice from a long cylindrical tube, into the space between 2 infinite, parallel plates set at right angles to the length of the supply pipe. It is assumed that motion of the fluid between the plates is permanently irrotational and that no cavitation or vorticity is present at the orifice. An expression involving Bessel functions is derived for the stream function and therefrom expressions are derived for the velocity components of the flow, the pressure at any point and the force upon any circular area of the plate facing the entrance orifice of fluid, and having its centre coincident with the centre of the orifice. J. S. G. T.

532.517

3791. Forces and moments in a slightly curved or convergent flow. PISTOLESI, E. *Comment. Pont. Acad. Sci.*, **8** (*No.* 22) 609–31 (1944) *In Italian.*—A verification of Tollmien's investigations [*Ingen.-Arch.* (*Aug.*, 1938)] on the influence of a slightly curved or convergent flow, on an immersed body. New formulae and important relationships between the potential distribution about the immersed body are derived, on the assumption that the source is at the body. Tollmien's equations for the moment are expanded and improved. L. J. G.

532.517.4

3792. Study of turbulence by light diffraction. HUBBARD, J. C., FITZPATRICK, J. A., THALER, W. J., CHANG, L. AND BEEBER, R. J. *Phys. Rev.*, **74**, 708–9 (*Sept.* 15, 1948).—Collimated light from a spark of 10^{-7} sec duration passes through the turbulent field, which in the case of a fluid jet is such that its axis is at right angles to that of the slit source. The diffracted slit image shows more intense side-flare in the presence of turbulence. As is known from Debye–Sears patterns a progressive change from turbulence to finer structure is revealed. H. H. HOP

532.52

3793. The passage of a perfect fluid through a critical cross-section or 'throat.' BINNIE, A. M. *Proc. Roy. Soc. A*, **197**, 545–55 (*July* 7, 1949).—A review is given of the methods previously adopted of calculating the discharge of a gas through a convergent-divergent nozzle and of a liquid over a broad-crested weir, through a Venturi flume with a horizontal bottom, and in a swirling state through a vertical nozzle. The assumption is made throughout that conditions are uniform over each cross-section of the constriction. Hugoniot's method is shown to be preferable, and it is used to examine the discharge of a liquid through a Venturi flume of any shape and of a swirling gas through a nozzle. It is pointed out that, if an external force is operating in the axial direction, the local velocity of sound or of a long wave, as the case may be, is not attained by the fluid at the exact geometrical throat of the constriction. For the general case of liquid flow, whether swirling or not, the axial velocity of streaming in the absence of external forces is shown to be equal at the throat to the velocity of a long wave. A

532.52

3794. On the origin of vortices in perfect inhomogenous fluids exposed to potential mass forces. CASTOLDI, L. *Acta Pont. Acad. Sci.*, **11** (*No.* 17) 207–18 (1947) *In Italian.*—Analytical examination of the possibility of applicaton of the hydrodynamic theorems of Lagrange, Thomson and Helmholtz, to the flow of an inhomogeneous ideal fluid subjected to potential forces, with a practical application to the case of a fluid flow from a cylindrical container. L. J. G

532.542.

3795. A new approximate solution in boundary value problems by the use of orthogonal curvilinear coordinates. UCHIDA, S. *J. Phys. Soc. Japan*, **3** 33–40 (*Jan.–Feb.*, 1948) *In English.*—Two approximate methods of solution of boundary value problems are considered. In one method fixed axes are chosen using curvilinear co-ordinates and the appropriate equations obtained by successive approximations. In the second method, from an initial system of curvilinear co-ordinates, one co-ordinate is corrected by successive approximations to fulfil the required boundary condition, and the remaining co-ordinates are determined by the conditions of orthogonality. The case of flow of compressible fluid past circular walls is worked out by both methods, and values obtained by experiment are given which show good agreement with calculated values. G. G

532.5

3796. The propagation of permanent-type waves in horizontal flow. THOMPSON, P. D. *J. Met.*, **5**, 166– (*Aug.*, 1948).—A solution is obtained to the equation governing the stream function ψ, for the case of 2-dimensional motion of a perfect fluid on a rotating earth. To represent motion of a permanent type $\psi = f(x - ct)$ where the x axis is towards the east and c is a uniform velocity of the ψ field. Boundar

conditions are applied at y_1 and y_2, and from the solution as modified by these conditions an expression to represent the phase speed of any wave is derived. The phase speed is found to depend on the difference of the wind shear at one lateral boundary and at the other. With wind shear taken as the same at both boundaries, the expression for the phase speed comes into agreement with results given by previous investigators. G. G.

CAPILLARITY 532.6

532.61.08 : 531.752

3797. A torsion microbalance for measuring low pressures of monolayers. KALOUSEK, M. *J. Chem. Soc.*, 894–901 (*April*, 1949).—A description of the apparatus and technique for measuring low surface pressures of monolayers is given. A fibre loop on the surface of a liquid contains a reference monolayer, and the monolayer to be studied is spread outside. If the ring is held at one end of a diameter and pulled at the other, the fibre forms two arcs of a circle. The difference of pressure within and outside the loop is measured by the tension required for extension. In the apparatus the tension required is measured by a torsion wire. A.

532.614.2

3798. Collections of particles of limited penetrability. Application to the study of fields due to surface and interfacial forces. MÉRIGOUX, R. *J. Phys. Radium* (*Sér.* 8) **9**, 236–44 (*July–Aug.–Sept.*, 1948) *In French.*—By assuming generally accepted expressions relating the distance and force between particles of limited penetrability expressions are derived for the internal pressure of a system, and for the latent heat of vaporization and the surface energy of a liquid. Expressions previously obtained [Abstr. 2054, 2519 (1946)] are used with the new ones to derive molecular parameters; a table gives the results for a number of liquids and liquefied gases. The theory for discontinuous fields is applied to solids and liquids. The model shows that an increase in penetrability causes a change in sign of the internal pressure and surface energy. The theory is illustrated with graphs and schematic drawings. R. A. W.

532.65

3799. The production of sprays and mists of uniform drop size by means of spinning-disc type sprayers. WALTON, W. H. AND PREWETT, W. C. *Proc. Phys. Soc., Lond. B*, **62**, 341–50 (*June*, 1949).—Spray of almost uniform drop size is formed when liquid is fed under suitable conditions on to the centre of a rotating disc and centrifuged off the edge. This method of spraying has been studied over a wide range of variables and homogeneous clouds have been produced in the drop-size range from 3 mm to 15 μ dia. The size of the spray drops is given approximately by the equation $d = 3{\cdot}8\,(T/Dp)^{\frac{1}{2}}/\omega$ where d = drop diameter, D = disc diameter, ω = angular velocity of disc, T = surface tension of liquid, ρ = density of liquid. The spray thus formed also contains a proportion of fine satellite drops, but their smaller distance of projection from the disc enables them to be removed from the cloud when their presence is undesirable. Relatively coarse sprays are easily produced by means of a simple electric motor-driven disc. The finer spray sizes require rotor speeds up to several 1 000 r.p.s. and high speed air driven "tops" have been used for this purpose. Suitable designs of apparatus are described. A.

532.65 : 551.578.1

3800. Electronic apparatus for the determination of the physical properties of freely falling raindrops. GUNN, R. *Rev. Sci. Instrum.*, **20**, 291–6 (*April*, 1949). —An apparatus is described for measuring the mass, velocity of fall, sign, and free electric charge of individual falling raindrops. Two vertically separated rings are so arranged that naturally charged raindrops fall through them and induce pulses on the grid of a vacuum tube amplifier which in turn operates a tape oscillograph. From the characteristic double pulses produced, the charges and transit times may be determined. The mass of the droplet is simultaneously determined by measuring the size of the spot produced when the drop falls on blueprint paper tape traversing the oscillograph. Short cuts for the reduction of data on drop sizes are given. A.

532.69

3801. A new type of micelle; solubility by film penetration. HARKINS, W. D. AND OPPENHEIMER, H. *J. Chem. Phys.*, **16**, 1000–2 (*Oct.*, 1948).—A n-long paraffin chain alcohol, amine or another polar nonpolar molecule (I) can penetrate the film of a soap micelle without increasing its thickness (contrast solubilization where the micelle is thickened by $\sim$12 Å). The term *penetration* is proposed. In penetration, the solubility decreases rapidly with the increasing length of the hydrocarbon chain of I, but the relationships are complex and may involve "molecular fitting"—e.g. 11-C alcohol is more soluble than 10- or 12-C. In solubilization the solubility increases with increasing length of I. The critical micelle concentration is lowered by penetration but not by solubilization. S. J. G.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 536.48

3802. Properties of liquid helium. KISTEMAKER, J. *Rev. Sci., Paris*, **86**, 176–87 (*Feb.* 1, 1948) *In French.* —Review of published work (mainly experimental) on the properties of liquid He up to 1947. H. L.

532.7 : 536.48

3803. The calculation of the thermodynamic pressure of a quantum liquid. YVON, J. *C.R. Acad. Sci., Paris*, **227**, 763–5 (*Oct.* 18, 1948) *In French.*—The deductions of Born and Green [Abstr. 2375 (1948)] regarding the pressure in a quantum liquid are discussed, and the outline of a proof showing that in such a liquid the hydrostatic and thermodynamic pressures are equal. F. E. H.

532.7 : 536.48

The present state of the theory of liquid He. *See Abstr.* 3947

532.712

3804. An explanation of the action of a semi-permeable wall and a new interpretation of osmotic pressure. TEIGE, K. *Bull. Int. Acad. Tchèque Sci.*, **46**, 83–9 (1945) *In English.*—The molecular sieve theory, the differential solubility theory and the conception that the solute exerts a kind of partial pressure, are criticized. A theory is now put forward in which the osmotic pressure is explained as the hydrostatic pressure which will just raise the vapour pressure of the solution to that of the solvent, by producing a meniscus in the capillaries. For aqueous solutions an osmotic pressure of 1 atmosphere would require that the liquid had penetrated to pores of $0{\cdot}15\ \mu$ diameter. The semipermeable membrane is assumed to allow free passage of water vapour, but to be non-wettable by the liquid. S. J. G.

532.72

3805. Thermal diffusion in liquids in a rotating system. TILVIS, E. *Comment. Phys. Math. Helsingf.*, **13** (*No.* 15) 59 *pp.* (1948) *In English.*—A rotating thermal diffusion apparatus ("separator") for solutions based on the method of Clusius and Dickel [*Naturwiss.*, **26**, 546 (1938); **27**, 148 (1939)] is described. An attempt to reconcile the experimental data obtained with Na_2SO_4 solution with the phenomenological theory of de Groot and co-workers [Abstr. 2796, 2798 (1946)] was unsuccessful. F. L.

532.72 : 532.133 : 541.64

3806. The rotatory diffusion constants of flexible molecules. RISEMAN, J. AND KIRKWOOD, J. G. *J. Chem. Phys.*, **17**, 442–6 (*May*, 1949).—Using the model and methods of a previous paper [Abstr. 3640 (1948)], the average components of the rotary diffusion tensor of a flexible molecule are calculated. The results obtained are found to be related to both the intrinsic viscosity and to the translational diffusion constant. In particular the rotatory diffusion constant of the molecule as a whole is shown to be a simple function of the intrinsic viscosity. The theory developed, in conjunction with the theory of intrinsic viscosity and translational diffusion, co-ordinates the results of the various hydrodynamical physical methods used in high polymer research. A.

532.73

3807. The liquidus curve for aluminium in mercury. LIEBHAFSKY, H. A. *J. Amer. Chem. Soc.*, **71**, 1468–76 (*April*, 1949).—The Al–Hg liquidus curve has been completed by measurements designed to give good results with dilute Al amalgams. Within the temp. range 76–312°, the % by weight of Al "soluble" in Hg is given by the equation $\log_{10}\% = 1{\cdot}240 - (1\,132/T)$ to within about 10%. The apparent heat of fusion in this system passes through a max. as the Al content is increased. In nearly pure Al, the value of this heat agrees remarkably well with the heat of fusion recommended by Kelley for this element. A.

532.74 : 536.422/.423

3808. Evaporation and surface structure of liquids. WYLLIE, G. *Proc. Roy. Soc. A*, 197, 383–95 (*June* 22, 1949).—The condensation coefficient (c.c.) of a liquid is defined as the ratio of the observed rate of evaporation under given conditions to the "expected" rate calculated from the known saturation vapour pressure, for the same conditions. Values of the c.c. < 1 have been reported in the past, but the accuracy of the experiments has been criticized on various grounds. Experimental work is described which establishes that the c.c. of glycerol at 18°C is $0{\cdot}052 \pm 0{\cdot}005$. Previous experimental determinations are reviewed in the light of this result, and it is found that for various liquids the c.c. $\sim$ the free-angle ratio defined by Kincaid and Eyring [Abstr. 4336 (1938)] on the basis of a simple model of liquid structure. This equality is not found for chloroform. The theory of evaporation is discussed on a model of the liquid surface consisting of a compact ordered layer with a mobile adsorbed layer of molecules above it. On the assumption that evaporating and condensing molecules pass through the adsorbed condition, it is shown that the c.c. is determined by the rates of exchange between substrate and adsorbed layer, and adsorbed layer and vapour, respectively. In particular, a c.c. near unity results if the rate of exchange between substrate and mobile layer is $\geq$ than that between mobile layer and vapour. The above assumption does not give a satisfactory explanation of the equality of c.c. and free-angle ratio for alcohol molecules. It is shown that for polar molecules which form an oriented surface layer in the liquid state it is to be expected that evaporation will take place mainly by direct exchange of molecules between the ordered layer and the vapour, although an adsorbed layer will be present. In this case an argument given by Herzfeld shows the condition for equality of c.c. and free-angle ratio to be that there should be no exchange of energy between rotational and translational co-ordinates in the process of evaporation. It is further concluded from a rather qualitative discussion that a major contribution to c.c. and free-angle ratio for the simple alcohols arises from restriction of rotation of the OH group about the C–O bond. A.

MECHANICS OF GASES 533

533.1

3809. The deposition of streaming Apiezon-oil mists in the thermal diffusion tube. The influence of particle size. WEBER, R. *Z. Naturforsch.*, **3a**, 181–2 (*March*, 1948) *In German.*—Continuation of Abstr. 2429 (1947) in which particles of size $0{\cdot}35\ \mu$ were produced by an atomizer working at 2·5 atm. pressure. Mists consisting of particles of size between 2 and $5{\cdot}8\ \mu$ were produced by a special atomizer working at 0·65 atm. pressure. The particles were observed by an ultramicroscope and the sizes calculated by using Stokes' law. The variation of deposition with temp. for the various mists was obtained, and the curves show that for the $0{\cdot}35\ \mu$ particles deposition suddenly starts at about 60°C, but for the 2 to $5{\cdot}8\ \mu$ particles not until about 185°C. As Clusius has shown previously [*Z. Ver. deutsch. Ing. Beih. Verfahrentechn.*, **2**, 24 (1940)] it would appear that for the range $0{\cdot}1\ \mu$ to $6\ \mu$ the force, on the suspended particles, produced by the temp. gradient decreases with increasing particle size. S. W.

533.15

3810. The self-diffusion coefficient of nitrogen. WINN, E. B. Letter in *Phys. Rev.*, **74**, 698–9 (*Sept.* 15, 1948).—N 7·4% enriched in N^{15}, was allowed to diffuse into normal N at the same temp. and pressure. The heavy N was placed in one Cu bulb and the normal N in a second, connected with the first by a Cu tube. Continuous analysis was made with a mass spectrometer. The mean of 5 diffusions at 20°C was $\varepsilon\eta = \rho D = 258 \pm 10$ micropoises (ρ = density, D = coeff. of self diffusion, η = viscosity, ε = constant related to intermolecular forces), whence $\varepsilon = 1{\cdot}48$ in good agreement with the value $\varepsilon = 1{\cdot}44$ calculated for normal N by Chapman and Cowling. S. J. G.

533.15 : 536.23

3811. On the diffusion of para hydrogen into ortho hydrogen. WALDMANN, L. AND BECKER, E. W. *Z. Naturforsch.*, **3a**, 180 (*March*, 1948) *In German.*—From theoretical considerations [Abstr. 777 (1947)] a thermal diffusion coefficient $\alpha_{70°K} = 0{\cdot}013$ $[1 - 10\gamma_0/9]$ has been calculated for ortho/para H mixtures. Here γ_0 is the mole-fraction of *o*-H and $\alpha > 0$ means enrichment of *p*-H at the cold wall. There should also be a difference in thermal conductivity even below 70°C where the specific heats of the two modifications are no longer different. Experiments with a Clusius–Dickels tube by Schäfer and Corte [Abstr. 1587 (1947)] with the temps. of the two walls at 80° and 220° respectively gave qualitatively the expected effect. In the present paper an attempt has been made to determine α by means of the diffusion-thermal effect using the streaming gas method [Abstr. 3085 (1947); 572 (1948)]. The interdiffusing gases contained 80% and 25% *o*-H. No thermo effect was found; from this follows $|\alpha| < 0{\cdot}01$, $0{\cdot}0006$, $0{\cdot}001$ at 20°, 90°, 195°K respectively. Measurement of the thermal conductivity showed that it differed by $< 0{\cdot}1\%$ at 20°K. H. L.

533.15 : 539.155.2

3812. The infinite separation tube with reservoir at the end. KLEMM, A. *Z. Naturforsch.*, **3a**, 211–16 (*April*, 1948) *In German.*—Derivation of an expression for the dependence of the concentration of a rare isotope in an infinite separation tube on time, distance from the end and volume of an attached reservoir. This result has been given independently by Breit and Friedman [Abstr. 706 (1948)] for the special case of separation by ionic transfer. In the present paper the formula is given in a general form applicable to any fractionation process. Particular reference is made to thermal diffusion, chemical exchange and ionic transfer. H. L.

533.16

3813. The viscosity of compressed gases. HULBURT, H. M. *J. Phys. Coll. Chem.*, **53**, 540–4 (*April*, 1949).—An expression for the viscosity of an imperfect gas at elevated pressures has been derived and shown to be applicable in predicting viscosity ratios below 1·6, using the equations of state of the gas. A.

533.17

3814. A flow-meter for high-temperature gases. COMINGS, E. W. AND JOHNSON, R. C. *Analyt. Chem.*, **21**, 290–2 (*Feb.*, 1949).—The flow-meter consists essentially of a sharp-edged orifice fitted with a shielded thermocouple. Gas temp. is measured by means of the thermocouple; chromel-alumel B wires (22 gauge) were found satisfactory for temps. approaching 2 000°F. The pressure drop across the orifice is measured by means of a manometer or pressure gauge. Mass rate of flow of gas is deduced from the pressure drop by using a well-known empirical relation. If the gas-temp. is also known and the gas is assumed perfect, the volume rate of flow can be found. The accuracy of the meter is ± 5%. A. SCH.

533.21

3815. Contribution to the study of sudden compressions; compressions by shock. CORNOU, M. *C.R. Acad. Sci., Paris*, **227**, 954–6 (*Nov.* 8, 1948) *In French.*—Gases contained within a cylinder were subjected to shock compression by applying a ram to the head of a piston. An ultra-rapid camera was used to register displacements of the ram and piston, in conjunction with a delicate time-recording mechanism. Curves were thus obtained representing the displacements of the weight with respect to the cylinder and the displacements of the piston with respect to the cylinder as functions of the time. The results obtained prove that the velocity of impact plays an important role in relation to the displacements. G. G.

533.56

3816. Pumping speed of an oil diffusion pump for hydrogen. SETLOW, R. B. *Rev. Sci. Instrum.*, **19**, 533 (*Aug.*, 1948).—A 100 l/sec pumping system with baffle, ionization- and thermocouple-gauges was used to measure the pumping speeds of an oil diffusion pump for differential pumping of H and for air. A graph of these pumping speeds against pump heater input indicates that the max. permissible backing pressure for H is < that for air. This and the relation between speeds for H and for air are explained, and it is recommended that oil diffusion pump jets should be designed for pumping specific gases. G. W.

533.59 : 541.124

Reactions of metals in high vacua. *See Abstr.* 4208

533.6.011 : 531.57

3817. Two methods of solution of one-dimensional non-steady problems of gas-dynamics. CAP, F. *Acta Phys. Austriaca*, **2** (*No.* 3) 224–38 (1949) *In German.*—A potential equation for non-steady one-dimensional compressible gas-flow is derived. This is linearized by means of a Legendre transformation and may be solved by the method of characteristics. An account is given of a graphical method of solution developed by Schultz-Grunow. This is applicable only to perfect gases. An extension to non-perfect gases is given. The extended method is illustrated by its application to the calculation of shot-travel in a gun from breech-pressure variation, taking account of pressure-distribution along the barrel. A. SCH.

533.6.011

3818. A note on the substitution principle for steady gas flow. PRIM, R. C. *J. Appl. Phys.*, **20**, 448–50 (*May*, 1949).—The Substitution Principle established

by Munk and Prim [*Proc. Nat. Acad. Sci.*, **33**, 137–41 (1947)] for flows of a gas having constant specific heats is extended to the wider class of fluids having a state equation of the form $\rho = P(p)S(s)$. The equations of motion for this class of fluids is reduced to a canonical form involving only the reduced velocity vector and the pressure. It is shown that explicit elimination of the pressure from these equations is possible only for those fluids whose state equation has the form $\rho = p^k S(s)$ with $k < 1$. Relations between the Mach number and stagnation pressure and the reduced velocity field are discussed for the class of fluids under investigation. A.

533.6.011.4 : 551.513

3819. On the eddy stress and viscosity in air currents. JOHANNESSEN, T. W. *Met. Ann.*, **2** (*No.* 14) 466–99 (1948) *In English.*—It has been assumed that a term can be introduced into the equation for smoothed wind fields due to the eddy motion within the general flow and that it represents the functional force produced by turbulence. The equation $-q\overline{v}\,\overline{v'} = \eta(d\bar{v}/dz)$ is assumed true for short or long time intervals. A detailed examination has, however, shown that this equation does not represent the eddy stress in average air currents smoothed over long or short periods. Laboratory experiments had indicated that a formula similar to Newton's for the stress can represent that for viscous fluids in turbulent motion provided the dimensions of turbulence are small. In reality turbulence in the atmosphere differs from laboratory turbulence in the stratification in the atmosphere and the change of wind velocity and direction with height. R. S. R.

533.6.011.5

3820. Methods for predicting phenomena in the high-speed flow of gases. LIGHTHILL, M. J. *J. Aeronaut. Sci.*, **16**, 69–83 (*Feb.*, 1949).—A synopsis of compressible fluid dynamics. It treats successively the foundations of the subject, the boundary layer, isentropic flow, plane waves and the differences between steady sub- and supersonic flow; the perturbation methods of solution, including the linearized theory of supersonic flow in its many ramifications, are described and compared with more exact work in certain cases, and the theory of characteristics is outlined. I. A.

533.6.011.5

3821. An interferometric study of supersonic channel flow. BERSHADER, D. *Rev. Sci. Instrum.*, **20**, 260–75 (*April*, 1949).—The Zehnder–Mach interferometer has been applied to the study of supersonic flow of air expanding from a pressure tank into the atmosphere through channels of rectangular cross-section. This was made possible by using plane-parallel glass plates for a pair of opposite walls of the channel. Two such channels were used, each about 1 cm in width and 2 cm in depth, one being a divergent channel (half-angle = 4·0°) and the other a Laval nozzle constructed by the "characteristics" method for $M = 1{\cdot}7$. It was found possible to measure the density distribution with a rather small estimated probable error ($\leqslant 2\%$). Knowledge of the stagnation temp. and pressure made it possible also to compute pressure, temp. and velocity. Results obtained for the potential flow agree, for the most part, within 1% with the well-known theory of isentropic channel flow. The interferometric technique has been used also as a guide in improving the Laval nozzle, giving quantitative data on the inhomogeneities resulting from small errors in construction. Further quantitative data was obtained on the degree of non-uniformity of the flow in the throat regions of both channels. The boundary layers, which reach a thickness of about 10% of the channel width near the orifice of the Laval nozzle, introduce further accuracy problems into the study of channel flow by interferometry. These are considered in some detail. Some of the considerations here will also apply to the interferometric analysis of flow in larger supersonic wind tunnels whose working sections are essentially channels of rectangular cross-section. A

533.6.011.

3822. On supersonic flow patterns. MUNK, M. M. *J. Appl. Phys.*, **20**, 302–5 (*April*, 1949).—For a definite Mach number, given by $M^2 = 4/(3 - \gamma)$, all Mach lines in a steady plane two-dimensional potential flow of a perfect gas with expansion exponent γ have zero curvature. The use and significance of this relation are discussed, and the hypothetical expansion law consistent with straight Mach lines is deduced. A

533.6.011.

3823. Flow through a rocket nozzle with and without vibrational equilibrium. PENNER, S. S. *J. Appl. Phys.*, **20**, 445–7 (*May*, 1949).—A procedure is outlined for calculating the max. changes in the exhaust velocity of gases which can be introduced during flow through a rocket nozzle as the result of vibrational time lags. Representative calculations have been carried out for a number of propellant systems. These calculations indicate that the vibrational time lags cannot produce changes in exhaust velocity $>$ a few %. The numerical values of the changes are found to depend not only on the nature of the gases but also on the occurrence or non-occurrence of chemical reaction during flow. A

533.6.011.8

3824. Applications of the theory of free molecule flow to aeronautics. ASHLEY, H. *J. Aeronaut. Sci.*, **16**, 95–104 (*Feb.*, 1949).—The breakdown of certain assumptions of conventional aerodynamics in the case of highly rarefied gas is shown to call for the use of the theory of free molecule flow in studying forces on bodies moving at altitudes $>$ 120–150 km in the earth's atmosphere. Techniques are developed for finding analytically or numerically the lift and drag coefficients of any object, based on 2 extreme opposite assumptions concerning the nature of reflection of molecules from surfaces. The drag of missiles is demonstrated to be negligibly small above 120 km except at extremely high speeds. I. A

533.6.013.2

3825. Momentum and energy diffusion in the turbulent wake of a cylinder. TOWNSEND, A. A. *Proc. Roy. Soc. A*, **197**, 124–40 (*April* 22, 1949).—A detailed experimental investigation of the turbulent motion in the wake of a circular cylinder, 0·953 cm diameter, placed in an air-stream of velocity 1 280 cm.sec^{-1}, has been carried out with particular reference to those quantities determining the transport of turbulent energy and mean stream momentum.

533.6.07

3826. The analogy between the results of wind-tunnel tests and those of a hydrodynamic flow. Teofilato, P. *Acta Pont. Acad. Sci.*, **11** (*No.* 9) 109–16 (1947) *In Italian.*—The analytical development of a hydrodynamic analogy for the case of a 2-dimensional air flow around an obstacle is based on Riabushevsky's assumption of quantitative similarity between a hydrodynamic flow and that of an ideal gas. This enables costly experiments in supersonic wind tunnels to be replaced by simple measurements in a hydrodynamic flow, the method being quantitatively valid for any profiles and angles of incidence. L. J. G.

MOLECULAR THEORY OF GASES 533.7

VIBRATIONS . ACOUSTICS 534

534.014.5

3827. On the synchronization of non-linear oscillating systems. Haag, J. *C.R. Acad. Sci., Paris*, **227**, 649–51 (*Oct.* 4, 1948) *In French.*—This note contains a résumé of results obtained in connection with the author's general theory relating to the synchronization and stability of vibrating systems, given in Abstr. 2525 (1946); *Ann. Fr. de Chronometrie*, 201–66 (1947); *Ann. Ec. Norm.* (3) **60**, 35–111, and (3) **61**, 73–117. See also *C.R. Acad. Sci., Paris*, **226**, 1567–8 (1948). G. G.

534.1

3828. On the conditions of auto-oscillation of vibrating systems. Rocard, Y. *Proc. Phys. Soc., Lond.*, **61**, 393–402 (*Nov.*, 1948) *In French.*—In a system of one degree of freedom, forces which tend to produce self-oscillations are of the nature of a negative resistance. In systems of more than one degree of freedom auto-oscillations may arise through the approach to equality of any two fundamental frequencies. In general, for the stability of any system, the resistance should be positive at each resonance of the reactance, and impedance should increase with frequency. These statements are discussed from the theoretical standpoint, and abundantly illustrated in their application to oscillations in locomotives and other vehicles, to wing flutter in aeroplanes, and to oscillations in other mechanical and electrical systems. See also Abstr. 533 (1948). G. G.

534.113

3829. Problems involving flexural vibrations treated by the wave-train method. Green, G. *Phil. Mag.*, **39**, 539–46 (*July*, 1948).—An introductory paper. The wave-train method is applied to problems involving the imposition of more than one condition at each boundary, or at any source or place of discontinuity. In particular, the differential equation governing flexural vibrations in a straight rod or beam is examined, and the general process of forming periodic, instantaneous and continuous solutions by summation of wave-trains is illustrated. The periodic force solution for a clamped-clamped bar is discussed. L. S. G.

534.213 : 537.228.1

Wave propagation in piezoelectric crystals. *See Abstr.* 3986

534.22

3830. Velocity of sound in fluids as a function of their structure. Schaaffs, W. *Z. Naturforsch.*, **3a**, 396–405 (*July*, 1948) *In German.*—A formula is derived from thermodynamical considerations which relates the velocity of sound in liquids to the quantities which appear in Van der Waals' equation of state. This formula indicates that there is a limiting velocity for a given homologous series which is somewhat lower than that observed. Measurements are described on organic liquids containing Cl and I constituents and on the isomers of heptane which suggest that the formula should contain an "impact factor." This is defined and its value is quoted for the liquids on which measurements were made. The effect on the velocity of variations in temp. can be deduced from the modified formula. H. J. H. S.

534.22 : 534.321.9

3831. Velocity of sound in rubber. Levi, F. and Philipp, H. J. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 233–50 (1948) *In German.*—The velocity of sound in rubber latex and in soft and hard vulcanized rubber was measured by an ultrasonic method. The velocities are 1 480, 1 440 and 2 320 m/s respectively. These values are $\geqslant$ those generally accepted on the basis of earlier measurements. The cubic compressibility of pure rubber latex is given as 2×10^{10} dynes/cm^2. H. J. H. S.

534.221

3832. Sound velocity and temperature change of molecular association. van Itterbeek, A. and de Bock, A. Letter in *Nature, Lond.*, **162**, 611–12 (*Oct.* 16, 1948).—The velocity of sound has been measured in CCl_4, C_6H_6, $(C_2H_5)_2O$ and CS_2 between 80°C and the melting point of these liquids. The relative association is calculated and plotted against temp., a straight line being obtained only for CCl_4. Calculations for He I and II are also given. G. F. H.

534.221

3833. Velocity of sound in free air. Lenihan, J. M. A. Letter in *Nature, Lond.*, **162**, 656–7 (*Oct.* 23, 1948).—Describes the method and results of measurement of the velocity of sound in free air at a frequency of 13 500 c/s ($\lambda \sim 1$ in). The mean value found for the velocity of sound at this frequency in dry air at a temp. of 273·16°K and pressure 1 013·2 ml, containing 0·03% of CO_2, was 331·45 $\pm$ 0·04 m/s. A. B. W.

534.221 : 534.321.9

3834. Ultrasonic velocity in some organic halides; constitutive effects. Lagemann, R. T., Evans, J. S. and McMillan, D. R., Jr. *J. Amer. Chem. Soc.*, **70**, 2996–9 (*Sept.*, 1948).—From measurement of the ultrasonic velocity of 25 organic halides at 20° it is concluded that the molecular sound velocity is an additive property which is very sensitive to constitutive influences. W. R. A.

534.221 : 534.321.9 : 533.74

3835. Ultrasonic investigation of molecular properties of liquids. WEISSLER, A. *J. Amer. Chem. Soc.*, **71**, 1272–4 (*April*, 1949).—The velocity of sound at 30° in 10 inorganic halides has been determined; on the average, it is < in the organic halides. Such properties as compressibility, ratio of specific heats, and the energy–volume coefficient have been computed from the sound velocities. There is no systematic variation with molecular weight in any of these properties. A.

534.221 : 541.68

3836. The speed of sound in hydrocarbons and its relationship to the molecular constitution. KLING, R. AND CRISTOPHE, J. *Rech. Aeronaut.* (*No.* 7) 59–64 (*Jan.–Feb.*, 1949) *In French.*—An attempt is made to relate the molecular structure of liquids, especially the hydrocarbons, and a number of physical properties. In addition to the speed of sound, the arguments are based on dispersion, absorption, thermodynamic considerations, etc. No important results appear to have been obtained yet. 23 refs. I. A.

534.232

3837. A theory of the crystal transducer for plane waves. CADY, W. G. *J. Acoust. Soc. Amer.*, **21**, 65–72 (*March*, 1949).—From the equation for propagation of acoustic plane waves through a solid medium, expressions are derived for the vibrational amplitude, radiated power, and electrical admittance of a plane-wave crystal transducer. The transducer consists of crystals, backing and diaphragm, radiating into any medium. The crystals may be an assemblage of flat bars vibrating lengthwise, or there may be a single flat crystal plate, or mosaic of plates, in thickness vibration. The equations take account of attenuation in the diaphragm, but not of attenuation in crystals and backing, nor of the effects of cement layers and lateral stresses between crystals. The general equations are specialized to the case in which the backing is air. Special attention is given to those frequencies at which the crystals, or diaphragm, or both, are in resonance. Some typical theoretical curves are shown, and a graphical method is described for the rapid plotting of curves. A.

534.232

3838. The substitution method of measuring the open circuit voltage generated by a microphone. HAWLEY, M. S. *J. Acoust. Soc. Amer.*, **21**, 183–9 (*May*, 1949).—An analysis of the substitution method is given which shows that the "normal" substitution voltage equals the open circuit voltage for all types of acoustic measurements and for any value of electric impedance loading the microphone. It is shown that the method recently proposed by some authors of removing the acoustic load from the microphone when applying the substitution voltage results in a substitution voltage which $\neq$ the open circuit voltage. It is also shown that a formula for the response of a transducer derived for a system in which the microphones are open-circuited may be used when the microphones are terminated by finite electrical impedances, by replacing the generated open circuit voltages in the formula by the corresponding "normal" substitution voltages. Consideration is given to the restriction in the definition of the pressure response of a transducer made necessary by the fact that the pressure on a microphone diaphragm is a function of the electrical impedance terminating the microphone. An experiment is described which involves a microphone coupled to a chamber, the acoustical impedance of which is high relative to that of the microphone. The results of this experiment agree with the conclusions of the analysis. A.

534.23

3839. Interactions between microphones, couplers and earphones. MORRICAL, K. C., GLASER, J. L. AND BENSON, R. W. *J. Acoust. Soc. Amer.*, **21**, 190– (*May*, 1949).

534.232 : 537.228.

3840. Application of activated ceramics to transducers. KOREN, H. W. *J. Acoust. Soc. Amer.*, **21**, 198–201 (*May*, 1949).—The conditions under which titanate ceramics may be made to have piezoelectric properties suitable for application to transducers are described. These conditions involve a selection of the titanate material to give a Curie point well above the working temp., polarization from an external voltage source within certain limits of potential gradient and time duration, and mechanical structure. Most common transducers have a mechanical impedance far below that of a solid block of ceramic. Multilamellar strips have been developed to provide the mechanical impedance required in a phonograph pick-up, microphone, or the like. These consist, in general, of a metal strip with a thin plate of ceramic soldered to one side or with thin plates soldered to both sides. As the multilamellar strip cools below the solidification point of the solder, the ceramic becomes pre-stressed in compression. This strip is then used in flexure in a transducer. It has many unique properties, especially for applications involving extreme conditions of humidity. Applications of this strip for a phonograph pick-up and to a microphone are shown. Precautions involved in controlling production of a pick-up are discussed. A.

534.23

3841. Non-linear distortion in dynamic loudspeakers due to magnetic effects. CUNNINGHAM, W. J. *J. Acoust. Soc. Amer.*, **21**, 202–5 (*May*, 1949).

534.232 : 621.395.61

3842. Phase characteristics of condenser microphones. WIENER, F. M. Letter in *J. Acoust. Soc. Amer.*, **20**, 707 (*Sept.*, 1948).—Gives briefly the results of measurements of magnitude and phase plotted against pressure for a type 640-AA condenser microphone. The calibration was carried out by using the reciprocity principle as described by Dimattia and Wiener [Abstr. 263 (1947)]. B. B. A.

534.24 : 536.4

Second sound in liquid helium II. *See Abstr.* 3948–50

534.321.

3843. Internal tuning differences due to players and the taper of trumpet bells. WEBSTER, J. C. *J. Acoust. Soc. Amer.*, **21**, 208–13 (*May*, 1949).

534.321.

3844. Absorption of ultrasonics by solids. MERCIER, R. AND BANDERET, N. *Helv. Phys. Acta*, **21** (*Nos* 3–4, 220 (1948) *In French.*—The absorption coeff.

measured at 0·4 Mc/s by incorporating a rod of the material to be studied in an ultrasonic generator. The rod is fixed on the generator, its free end acting as a radiator in oil containing the ultrasonic interferometer. Measurement is made of the pressure maxima in the interferometer for various rod lengths and the absorption coeff. determined. G. F. H.

534.321.9

3845. Ultrasonic velocities and absorption in gases at low pressures. ZARTMAN, I. F. *J. Acoust. Soc. Amer.*, **21**, 171–4 (*May*, 1949).—Improvements to an ultrasonic interferometer are discussed. As a result a greater sensitivity to acoustic reactions is obtained and the reproducibility of the data is greatly improved. Velocity measurements in dried CO_2-free air, dried N_2 and dried H_2 are given. Amplitude absorption coefficients for H_2, N_2 and CO_2 are also included. Measurements are made over the temp. range from 9°C to 36·6°C and over the pressure range from 82·17 cm Hg to 0·45 cm Hg. The frequencies extend from approximately 500 kc/s to 2·16 Mc/s. A max. value for the absorption in H, attributed to molecular absorption, is located at an f/p ratio of approximately 10 Mc/s/atmos. A.

534.321.9

3846. Supersonic waves in water–alcohol–sodium chloride mixture and analysis of its intermolecular action. PARSHAD, R. *J. Acoust. Soc. Amer.*, **21**, 175–6 (*May*, 1949).—Supersonic velocities and adiabatic compressibilities of a series of mixtures of water–ethyl alcohol–sodium chloride have been found. In general, maxima of sound velocities and minima of adiabatic compressibilities were obtained. With increase of salt concentration, the depth of the minimum of compressibility decreased and shifted towards the value for alcohol free-salt water, and for 3N concentration of salt, no minimum at all remained. The phenomenon has been explained as caused by the depolymerization of water by NaCl. The explanation supports earlier results on the water–alcohol system. A.

534.321.9

3847. A visual method for demonstrating the path of ultrasonic waves through thin plates of material. BURTON, C. J. AND BARNES, R. B. *J. Appl. Phys.*, **20**, 462–7 (*May*, 1949).—A visual method for studying the path of ultrasonic waves through thin plates of material has been devised, and a set of photographs showing the complexity of ultrasonic reflection and transmission by metal plates has been obtained. An attempt has also been made to estimate the critical angles of total reflection for dilatation and shear waves by visual examination of the reflection of a supersonic beam. Using these data, Young's modulus and the shear modulus for a $\frac{1}{16}$ in Al sheet have been determined and the values are compared with those obtained using a previously described electrical method and with published data. A.

534.323

3848. Suggested reference level nomenclature. SALMON, V. Letter in *J. Acoust. Soc. Amer.*, **20**, 707 (*Sept.*, 1948).—In the literature of acoustics sound pressure levels are given in db above a reference pressure p_0 by the relation $L = 20 \log_{10}(p/p_0)$. In air p_0 has been taken as 0·0002 dyne/cm², whereas in underwater acoustics p_0 is often quoted as 1 dyne/cm². The author suggests the former should be given the "unit abbreviation" dbg (*g*ases) and the latter dbl (*l*iquids). A table is given in the paper indicating suggested values of quantity, reference value, level symbol, and unit abbreviation for the more common acoustical quantities. A. B. W.

534.37 : 539.67

Damping in metals. *See Abstr.* 4203

534.42

3849. A composer's music box. WATSON, R. B. *J. Acoust. Soc. Amer.*, **21**, 214–16 (*May*, 1949).—The box is an electro-acoustic tone generator producing single tones. It is played in much the same way as a musical score is written. It has a pitch range of about an octave and an intensity range of about 40 db. Electrical circuits provide nearly constant tone structure independent of the fundamental frequency, and provide considerable variation in attack and decay times. A.

534.64

3850. The acoustic reactance of small circular orifices. BOLT, R. H., LABATE, S. AND INGÅRD, U. *J. Acoust. Soc. Amer.*, **21**, 94–7 (*March*, 1949).—A precise experimental study of the reactive component of the complex impedance of small circular orifices has been made for a number of orifices varying in dia. from 2 to 0·357 cm, with dia./thickness ratios from 4 to 40, over the frequency range from 200 to 1 000 c/s. The measurement of the impedance is performed with a precision impedance tube. A theoretical correction for the influence of the tube walls is applied by considering the orifice to act as a plane piston and taking into account the influence of all possible higher order modes of the tube in the neighbourhood of the orifice. Comparison between calculated and measured values of reactance shows that, as far as this quantity is concerned, the assumption that the orifice acts like a plane piston appears valid for radii $\geqslant 1$ cm for "thin" orifices within the range of variables specified above. For orifices of radii < 1 cm, however, a modification of the radius is necessary to make the classical theoretical equation for orifice reactance fit the measured data. The observations and analyses reported are restricted to wavelengths $\geqslant$ the hole diameter and to the low velocity region where reactance is independent of particle velocity. A.

534.75 : 612.85

3851. The effect of white noise on the loudness of speech of assigned average level. POLLACK, I. *J. Acoust. Soc. Amer.*, **21**, 255–8 (*May*, 1949).—Continuous recorded speech passages were presented against a background of white noise and against a quiet background. The effect of the noise on the loudness of speech was determined by having listeners adjust the level of speech heard in quiet to sound equal in loudness to an assigned average level of speech presented against selected levels of background noise. In general, it was found that (1) low noise levels produce a proportionately lower depression in the loudness level of speech than higher noise levels; (2) as a first approximation, however, the effect of noise on the loudness of speech is a function of the

speech-to-noise ratio rather than of the level of the speech alone or of the noise alone; and (3) under none of the experimental conditions did white noise actually increase the loudness of speech (the "Egan effect"). The assumption that a given level of noise subtracts a constant number of loudness units from speech (regardless of the level of the speech) was found to be fairly adequate in describing the experimental results. A.

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535.14

3852. On the mathematical representation of light in cosmology in terms of wave geometry. TAKENO, H. *J. Sci. Hirosima Univ., Ser. A*, **13**, 163–72 (1944) *In Japanese.* M. R.

535.23.08 : 537.312.5

3853. The effect of room temperature radiation on the infra-red response of lead telluride photoconductors. SIMPSON, O. *Proc. Phys. Soc., Lond.*, **61**, 486–7 (*Nov.*, 1948).—PbTe photoconductors are sensitive as far as 5·5 μ, at which thermal noise is appreciable. This is reduced by cooling. At −190°C the PbTe cell is an excellent long-wave detector (up to 5·5 μ). With the cell and its enclosure at −190°C the conductivity is much less than when the enclosure is kept at room temp. This is due to the constant irradiation of energy from the enclosure. At temps. $>$ −140°C conductivity is negligible. W. S.

535.23.08 : 536.37

3854. The evaporographic method. LECOMTE, J. *J. Phys. Radium*, **10**, 27–31*D* (*April*, 1949) *In French.*—Records of i.r. spectra up to 9 μ wavelength have been made with exposures of only 1 min. The detection and recording equipment consists of an extremely thin film (0·01 μ) of celluloid or similar substances, coated on one side with a substance which is highly absorptive in the i.r. range and thereby selectively heats the film according to wavelength and intensity. The other side of the film is coated with a substance which evaporates or sublimes $\propto$ the heat produced by the absorption in the other coating. The conditions under which best results will be attained are: (1) the thermal capacity of the 3-layer arrangement must be a minimum, (2) the incident i.r. energy must be completely absorbed, (3) the complete equipment must be enclosed in an atmosphere whose pressure = the saturated vapour pressure of the sublimating substance. The evaporographic cell was used in taking i.r. pictures of factory chimneys in rural surroundings, and other hot objects. W. S.

535.245

3855. Report on colorimetry and artificial daylight. *J. Opt. Soc. Amer.*, **38**, 803 (*Sept.*, 1948).

535.247 : 551.521.12

3856. Radiation measurements in South Finland with bioclimatic ultraviolet dosimeter. LUNELAND, H. AND RAUNIO, N. *Comment. Phys. Math., Helsingf.*, **13** (*No.* 2) 13 *pp.* (1948) *In German.*—Details some measurements made in the vicinity of Helsingfors during July–September, 1943, of ultraviolet radiation using a dosimeter based on a photochemical reaction. The instrument consisted of a quartz tube containing a colourless solution of sulphite of *p*-Fuchsin + excess sulphite. After irradiation, the degree of reddening was compensated with green filters. It was necessary to correct the results for the change in sensitivity with temp., for which an equation is given. It is considered that the results obtained with this instrument compare with the erythema sensitivity of skin in the region 315–250 mμ better than measurements made with a Cd cell. T. A.

535.247

3857. Comparison between a thermoelectric and photoelectric photometer with respect to their sensitivity to temperature variations of the light source. SCHÖNTAG, A. *Z. wiss. Photogr.*, **43** (*Nos* 1–8) 60–7 (194 *In German.*—A comparison of density measurements on photographic plates by a Se cell and a thermopile shows that for equal galvanometer deflections the short-period variations are smaller for the thermopile. The variations, occurring in intervals of $<$ 30 se are shown to be due to fluctuations in the source of light. The max. value for the cell is 0·060%, for the thermopile 0·022%. The difference is explained by Planck's radiation law, the two instruments registering radiation in different parts of the spectrum. Graphs are given, and good agreement between theory and experiment is obtained. R. A. V.

535.312 : 531.717

Testing of polished or fine ground surfaces for flatness. *See Abstr.* 3781

535.317.25 : 771.35

3858. The photographic and visual resolving power of lenses. II. Photographic resolving power. SELWYN, E. W. H. *Photogr. J.*, **88 B**, 46–57 (*May–June* 1948).—[See Abstr. 2410 (1948)]. When a photograph is taken of a sine-curve test object the image in the emulsion layer has a sine-curve intensity distribution but of lower amplitude than that of the aerial image, owing to diffusion of light in the emulsion. The corresponding variation in transparency on development will be greater or less according to the degree of development, but for the small variations near the limit of resolution will retain an approximate sine-curve character. Owing to the granularity of the photographic material the uniformity of variation of transparency is disturbed, as if by the superposition of an irregular fluctuation in density. Theoretical arguments suggest that the difference in density between the light and dark parts of the test object image will be visible if it is $> 2 \log_{10} e \times 0{\cdot}003G/R$, where G is the granularity in density microns, and R the reciprocal of the separation in mm between lines in the image. This supposes that the magnification used for observing the negative is about $\frac{1}{4}$ of a condition which theoretically leads to the maximum observable value of R for any given negative. The formula derived theoretically for the resolving power is $a\gamma P(R) = 0{\cdot}003GR$, where $2a$ is the total amplitude of the brightness variation of the test object relative to the average brightness, and γ the slope of the characteristic curve of the photographic material at the density of the negative (G is measured at the same density). $P(R)$ is the factor by which a is reduced, in the image, by reason of the finite size

the disc of confusion of the lens and the diffusion of light in the emulsion layer. The conclusion was tested experimentally by taking photographs with different degrees of exposure of sine-curve test objects with a wide range of values of a. It was found that the magnification leading to maximum resolving power was equal to $\frac{2}{3}$ of R, and that the right hand side of the above equation should be more nearly equal to $0{\cdot}0004(GR)^{1{\cdot}5}$. Despite the difference in form, the latter expression is of the same order of magnitude as $0{\cdot}003GR$ for normally occurring values of G and R. A.

535.323.08 : 535.417

3859. Refraction investigations with the Mach–Zehnder interferometer. GÜNTHER, N. *Optik*, **3**, 517–20 (*July–Aug.*, 1948) *In German.*

535.323 : 537.32

Refractive index of barium titanate. *See Abstr.* 3997

535.324.2

3860. Refractive index of hydrogen peroxide solutions. A revision. GIGUÈRE, P. A. AND GEOFFRION, P. *Canad. J. Res. B*, **27**, 168–73 (*March*, 1949).—Values for the refractive index of aqueous solutions of H_2O_2 previously reported have been found in error by more than the estimated accuracy of measurements. The error is $\propto$ the concentration of the solutions and amounts to about 5×10^{-4} for the pure peroxide. More accurate data have now been obtained by using an instrument of higher precision and by refining the analytical method. In addition, some anhydrous H_2O_2 has been prepared; its refractive index at 25°C was $1{\cdot}4067_2 \pm 0{\cdot}0001$ with an average temp. coeff. of $3{\cdot}4\times10^{-5}$ per degree. A.

535.33 : 551.593.55

Emission spectra of the upper atmosphere at twilight. *See Abstr.* 4333

535.33 : 551.593.9

The emission spectra of the night sky and aurorae. *See Asbtr.* 4342–6

535.33 : 551.594.5

Spectra of hydrogen, helium and nitrogen in the Aurora Borealis. *See Abstr.* 4351, 4356

535.33 : 551.594.5

New aspects of the problem of interpreting auroral radiations. *See Abstr.* 4357

535.33.072

3861. Vibrational bands measured with a thallium bromide–iodide prism. PLYLER, E. K. Letter in *J. Chem. Phys.*, **16**, 1008 (*Oct.*, 1948).—Thin layers of polyethylene or polystyrene form suitable transparent windows for cells in the region 24–40 μ. Using such cells ($> 0{\cdot}4$ mm thick) and a spectrometer with a thallium bromide–iodide prism bands for some 30 substances have been investigated and are reported on in a preliminary way. W. R. A.

535.33.072

3862. On new constructions of spectral apparatus. KHRSHANOVSKII, S. A. *Izv. Akad. Nauk, SSSR*, **12** (*No.* 4) 482–8 (*July–Aug.*, 1948) *In Russian.*—A universal monochromator for the visible spectrum and a triple-prism glass spectrograph, designed and built in the USSR, have been described as well as some auxiliary apparatus. F. L.

535.337

3863. The quadratic Zeeman-effect in the principal series of caesium, rubidium and potassium. HARTING, D. AND KLINKENBERG, P. F. A. *Physica, 's Grav.*, **14**, 669–83 (*Feb.*, 1949).—The quadratic shift due to the atomic diamagnetism has been observed in the principal series of Cs, Rb and K in absorption by means of the Amsterdam cyclotron magnet and a grating mounting. The theoretical formula for the quadratic Zeeman-effect is shown to account reasonably well for the observed displacements. In Cs weak components are found corresponding to electron transitions involving $\Delta m_s = \pm 1$, which are to be expected in the intermediate stages between anomalous Zeeman-effect and complete Paschen–Back effect. A.

535.338 : 535.33.03

3864. Addendum: Continuous spectra and OH absorption in carbon monoxide-oxygen explosions. HORNBECK, G. A. Letter in *J. Chem. Phys.*, **16**, 1005 (*Oct.*, 1948).—Some band structure in the emission spectra of CO–O_2 explosion flames is identified with the $^3\Sigma \rightarrow {}^3\Sigma$ Runge bands of the neutral O molecule. A preliminary note. A. G. G.

535.338.333

3865. Isotopic shift in the helium line spectrum. ANDREW, A. AND CARTER, W. W. Letter in *Phys. Rev.*, **74**, 838–9 (*Oct.* 1, 1948).—The wavelength difference between the 2^1P–3^1D, λ6678, line in He^3 and in He^4 was measured by means both of a concave grating and of a Fabry–Pérot interferometer and found to be $0{\cdot}467 \pm 0{\cdot}004$ Å. This result is in very good agreement with theoretical predictions. L. P.

535.338.333 : 539.155.2

3866. New determination of the isotopic shift. IVANENKO, D. D. AND TSANDER, A. F. *J. Exp. Theor. Phys.*, **18**, 434–7 (*May*, 1948) *In Russian.*—The use of electron functions allowing for finite dimensions of the nucleus permits a more precise calculation of the isotopic shift and of other extra-nuclear effects. A.

535.343

3867. Absorption intensities of ethylenes and acetylenes in the vacuum ultraviolet. PLATT, J. R., KLEVENS, H. B. AND PRICE, W. C. *J. Chem. Phys.*, **17**, 466–9 (*May*, 1949).

535.343

3868. Spectral resemblances of cata-condensed hydrocarbons. KLEVENS, H. B. AND PLATT, J. R. *J. Chem. Phys.*, **17**, 470–81 (*May*, 1949).

535.343

3869. Spectral resemblances in azulene and naphthalene. MANN, D. E., PLATT, J. R. AND KLEVENS, H. B. *J. Chem. Phys.*, **17**, 481–4 (*May*, 1949).

535.343

3870. Classification of spectra of cata-condensed hydrocarbons. PLATT, J. R. *J. Chem. Phys.*, **17**, 484–95 (*May*, 1949).

535.343 : 541.651

3871. The effect of alkyl substitution on the spectra and ionisation potentials of some fundamental chromospheres. PRICE, W. C. *Chem. Rev.*, **41**, 257–72 (*Oct.*, 1947).—The effect is illustrated by an extensive collection of best values. Thermochemical data are used to show that the reductions in ionization potential

are due to a relatively large stabilization of the molecular ion accompanying the introduction of the additional alkyl group. Although small stabilization of the unexcited neutral molecule occurs on alkyl substitution, this is of a lower order of magnitude than that associated with the ionic state. The greater relative stabilization of the molecular ion is implicit in the theory of hyperconjugation, but the effects observed seem to be larger than can be accounted for on the simple theory. It is thought that various charge-transfer effects occurring in the ionic state are responsible for a great part of the reduction. The red shifts of many absorption bands on alkyl substitution are partly attributed to similar causes. There are 41 references. H. H. HO.

535.343–31

3872. Ultraviolet absorption spectra of substances dissolved in compressed gases. VODAR, B. AND ROBIN, S. Letter in *J. Chem. Phys.*, **16**, 996–7 (*Oct.*, 1948).—The use of compressed A, N_2 and H_2 as solvents transparent to 1 300 Å is suggested and illustrated for phenanthrene in A up to 1 200 kg/cm pressure. Special care is required to exclude impurities. D. H. W.

535.343.2 : 535.323

3873. Dispersion of anthracene crystals in the visible part of the spectrum. OBREIMOV, I. V., PRIKHOTKO, A. F. AND RODNIKOVA, I. V. *J. Exp. Theor. Phys., USSR*, **18**, 409–18 (*May*, 1948) *In Russian.*—The 3 principal refractive indices were measured for a set of wavelengths in the visible spectrum, and a two-term formula for the dispersion was derived. From this it becomes clear that the violet absorption band of anthracene belongs to the strong absorption bands with a vibrator force of ~ 1. A.

535.343.32

3874. On the spectra of crystalline salts of rare earths. HELLWEGE, K. H. *Naturwiss.*, **34** (*No.* 8) 225–31 (1947) *In German.*—A survey of current research. Absorption spectra of aqueous solutions of chlorides and some details of absorption and emission spectra of various compounds are shown. F. L.

535.343.4

3875. On the calculation of the absorption coefficient at the middle of a resonance line. AUSLÄNDER, J. *Bull. Soc. Roumaine de Phys.*, **47** (*No.* 84) 25–8 (1946) *In German, Summary in English.*—Expressions are derived for the transparency, for its own resonance line and for zero magnetic field, of a layer of length l of monatomic vapour, and, assuming a Doppler distribution for the absorption lines, for the transparency for the emission lines, as a function of k_0, the absorption coefficient at the middle of the resonance line, and l. S. W.

535.343.4

3876. Atmospheric absorption of water vapour between 1·42 μ and 2·50 μ. MOHLER, O. C. AND BENEDICT, W. S. Letter in *Phys. Rev.*, **74**, 702–3 (*Sept.* 15, 1948).

535.343.4

3877. Absorption of water vapour between 1·34 μ and 1·97 μ. NELSON, R. C. AND BENEDICT, W. S. Letter in *Phys. Rev.*, **74**, 703–4 (*Sept.* 15, 1948).—The absorption spectrum of water vapour has bee analysed from recordings made with a PbS cell, usin a 11 m absorbing path. Intensities in the tw principal regions, 1·34 μ to 1·48 μ and 1·78 μ t 1·97 μ, were controlled by varying the humidity o the air sample. Within the first wavelength interva absorption is due predominantly to the (101) band In the 1·9 μ region two bands are effective, the stron (011) band and the weak (110) band (rel. intensities 50 : 1); only the strongest lines of the latter ar resolvable. D. R. B

535.343.

3878. On the absorption spectrum of nitric oxid molecule in the extreme ultraviolet region. II. TANAKA Y. *J. Sci. Res. Inst. Tokyo*, **43**, 160–7 (*April*, 1949 *In English.*—Using a 3 m grazing incidence typ vacuum spectrograph, the absorption bands of NO in the extreme ultraviolet region were investigated The predissociations in the γ- and δ-bands wer clearly observed and Herzberg and Mundie's dis cussion [Abstr. 1843 (1940)] for them was proved t be correct. On account of the weak appearance o the β-progression the predissociation predicted b Kaplan and discussed by Herzberg and Mundie wa not observed. Intensity distributions of β- an γ-bands progressions were compared with the result calculated by Schmid [*Z. Phys.*, **64**, 84 (1930)]. A

535.343.4–1

3879. Limiting sensitivity of a microwave spectro meter. TOWNES, C. H. AND GESCHWIND, S. Letter i *J. Appl. Phys.*, **19**, 795–6 (*Aug.*, 1948).—A correctio to the discussion of Hershberger [Abstr. 3249 (1948)] D. H. W

535.343.4–14 : 539.13

3880. Preliminary analysis of the microwav spectrum of ethylene oxide. SHULMAN, R. G. DAILEY, B. P. AND TOWNES, C. H. Letter in *Phys Rev.*, **74**, 846 (*Oct.* 1, 1948).—Four lines, with $\Delta J =$ in the rotational spectrum of ethylene oxide nea 24 000 Mc/s are detected and identified using th Stark effect. The derived moments of inertia ar 31·9, 36·7 and $56{\cdot}7\times10^{-40}$ g-cm² which, if C–H i assumed 1·09 Å, lead to an H–C–H angle of 121°. D. H. W

535.345 : 535.39

3881. Measurements of light transmission of glass DRESLER, A. AND HELWIG, H.-J. *Optik*, **3**, 504–1 (*July–Aug.*, 1948) *In German.*—Describes method of measuring transmission coefficients of glass fo parallel and diffuse light. Results are given an discussed for surfaces after different etching treat ments. G. O.

535.347 : 535.514.

3882. The dichroism of the cellulose dye comple and its technical application as light polarizer KÄSEMANN, E. *Optik*, **3**, 521–36 (*July–Aug.*, 1948) *I German.*—The light polarizer developed in German about 1939 under the name of "Cellopolarfilter" i described both from the theoretical and technica point of view. F. L

535.361.2 : 535.662.

3883. The diffusion of light by ground glass, with special reference to color changes. MIDDLETON

W. E. K. AND SMITH, F. D. *Canad. J. Res. F*, **27**, 151–66 (*March*, 1949).—By special methods of grinding it has been found possible to make reproducible ground-glass surfaces. A series of six surfaces of increasing roughness was produced in crown glass, and a similar series in flint. These were illuminated at normal incidence by 2 850°K light in a photoelectric goniophotometer and intensity was measured at various angles. The apparent colour temperature of the light diffused at each angle was also measured photoelectrically, with visual checks at some angles. Photomicrographs were taken of some of the surfaces, and finally the recording spectrophotometer was used to measure the diffuse reflectance, diffuse transmittance, and transmittance over a ½-angle of ~ 8°, of several glasses. Some sandblasted samples were also studied. The transmitted light is most reddish at 0°, while at angles of > 60° most of the glasses raise the apparent colour temperature of the light. With the most finely ground glasses the colour temperature at 0° reaches 2 300°K. Some theoretical studies lead to the belief that most of the colour changes are due to scattering, while diffraction plays a minor part. A.

535.37

3884. On the kinetics of the phosphorescence of organic materials. SVESHNIKOV, B. YA. *Izv. Akad. Nauk, SSSR (Ser. Fiz.)* **13** (*No.* 1) 67–76 (1949) *In Russian.*

535.37

3885. Luminescence of glasses containing Cu, Pb and Sm. WEINBERG, T. I. *Izv. Akad. Nauk, SSSR (Ser. Fiz)* **13** (*No.* 1) 203–8 (1949) *In Russian.*

535.37 : 541.651

3886. Phosphorescence and the rôle of the triplet state in the electronic excitation of complex molecules. KASHA, M. *Chem. Rev.*, **41**, 401–19 (*Oct.*, 1947).—A discussion is given of the researches of Lewis and his associates which led to the identification of the phosphorescent state with the lowest triplet state of a complex molecule, and can be regarded as a supplement to the basic papers [*J. Amer. Chem. Soc.*, **63**, 3005 (1941); **66**, 2100 (1944); **67**, 994, 1232 (1945)]. In addition a section has been added on the mechanism of excitation of the triplet state of complex molecules. The point of view adopted is that, since metastabilty of electronic levels may be due to various causes a phosphorescent state may not be identified as a triplet state until definite physical evidence for this identification has been obtained. H. H. HO.

535.371

3887. The extinction of the fluorescence of iodine vapour by nitrogen. GLICENSZTEJN, H. *Bull. Int. Acad. Polonaise Sci. Lett. A*, (*Nos* 4–10) 150–8 (*April–Dec.*, 1939) *In French.*—0·5 mm of N_2 is found to reduce the fluorescence of I_2 (0·13 mm) by a factor of 0·35 ± 15%, this factor being independent of the exciting line, of which there are 5 examples from 5 086–5 893 Å, and the particular term of the resonance series investigated. D. H. W.

535.371 : 538.22

Some magnetic properties of manganese-activated luminescent solids. *See Abstr.* 4081

535.372

3888. On the luminescence of fluorspars. RWATSCHEW, W. P. *Bull. Soc. Roumaine de Phys.*, **44** (*No.* 81) 9–17 (1943) *In German.*—Visible and u.v. luminescence spectra of natural fluorspars have been measured, and the law of the decay of the intensity of u.v. fluorescence of fluorspars has been studied. There have been observed 2 types of u.v. luminescence spectra: (1) with a single band at 4·11 eV (300 mμ), (2) with the former band and another at 4·41 eV (280 mμ). It has been found that fluorspars having 2 bands in the u.v. have also a band in the yellow-green region which can be explained, according to bibliographical data, by the presence of Y. Hence, the 4·41 eV band is probably due to Y-containing impurities. The rates of decay of luminescence were found to obey the simple hyperbolic law $I = At^{-\alpha}$ which confirms the hypothesis of a bimolecular photochemical reaction in fluorspar crystals. F. L.

535.372

3889. On the inadequacy of the measurement of emission characteristics of fluorescent substances without spectral resolution. BODÖ, Z. Letter in *J. Opt. Soc. Amer.*, **38**, 815 (*Sept.*, 1948).—Fluorescence spectra broaden with temp. increase, and their peaks may change in position, or in relative intensity if several bands are present. Temp. dependence curves are therefore likely to be in error unless photocells and filters are carefully chosen, but spectrographic measurements alone are preferable. S. T. H.

535.372

3890. Temperature dependence of the emission bands of zinc oxide phosphors. NICOLL, F. H. *J. Opt. Soc. Amer.*, **38**, 817 (*Sept.*, 1948).—A rise of temp. of 225°C causes a decrease to ¼ of the intensity of the u.v. emission band of ZnO phosphors and to $\frac{1}{2\cdot3}$ of that of the visible band. The wavelength shifts are 1·2 Å per °C (to longer wavelengths) and zero respectively. The u.v. absorption also appears to shift to longer wavelengths with rising temp. C. B. A.

535.372

3891. Infra-red stimulability of $CaSiO_3$: Pb and $CaSiO_3$: (Pb + Mn). SCHULMAN, J. H., GINTHER, R. J. AND EVANS, L. W. Letter in *J. Opt. Soc. Amer.*, **38**, 817–18 (*Sept.*, 1948).—Both phosphors show i.r. stimulability on irradiation with unfiltered Hg lamp, although this is not displayed by $CaSiO_3$: Mn or $CaSiO_3$. Response is also observable after spark coil and X-ray excitation. Stimulation spectra are identical for both phosphors. W. R. A.

535.372

3892. The representation of the emission bands of luminescent solids by gaussian distribution functions. BRINKMAN, H. AND VLAM, C. C. *Physica, 's Grav.*, **14**, 650–68 (*Feb.*, 1949) *In English.*—The spectral distribution curves of various luminescent solids (tungstates, sulphides and silicates) have been measured and resolved into individual bands. Plotting the energy as a function of frequency (wave number) these individual bands can be described by symmetrical functions $I(\nu) = Ae^{-B(\nu-\nu_0)^2}$. The use of curves representing the intensity as a function of wavelength or the number of emitted photons as a function of frequency respectively is discussed; in both cases the

individual bands have no symmetrical shape and the analysing procedure is complicated. The use of the frequency scale is therefore recommended. In a few cases the temperature dependence of the peak position and the band breadth have been determined. A.

535.372

3893. Investigation of the phosphorescence spectrum of benzene. DIKUN, P. P. AND SVESHNIKOV, B. YA. *Dokl. Akad. Nauk, SSSR*, **65** (*No. 5*) 637–40 (1949) *In Russian.*

535.375.5

3894. Anisotropy of the Raman effect in cubic crystals. MATHIEU, J. P. *J. Phys. Radium* (*Sér.* 8) **9**, 83 (*March*, 1948) *In French.*—The intensity and the depolarization of the line depend on a derived tensor which does not possess spherical symmetry. As a result, the depolarization of the degenerate vibrations is not zero, but varies between 0 and 3 for the doubly degenerate ones, and between 0 and 2 for the triply degenerate ones, according to the orientations of the cubic axes with reference to the directions of illumination and observation. These conclusions have been verified experimentally. A. C. M.

535.375.5

3895. New apparatus for Raman spectroscopy of powdered crystals. HARRAND, M. *J. Phys. Radium* (*Sér.* 8) **9**, 81–2 (*March*, 1948) *In French.*—Light scattered in the forward direction by thin layers of fine powders is observed. A monochromator of relative aperture $F/0{\cdot}7$ illuminates the sample, placed over a hole of 0·3 mm dia., at the normal position of the exit slit. The illuminated sample is focused on the slit of the spectrograph ($F/2{\cdot}3$). The thickness of the sample has to be related to the size of the grains, a compromise being necessary between the extremes of too little absorption of the exciting light, and too great absorption of the Raman light. Powders having a slight yellowish tinge need to be somewhat thinner than the colourless ones. Among the results obtained, salol gave a good spectrum in 30 hours, and a complete spectrum in 60 hours, and a line was found as low as 253 cm^{-1}. Chalcone, a coloured substance, gave the intense lines in 5 hours, and a complete spectrum in 40 hours; among the lines are 1 601 and 1 612 cm^{-1}, due to the double bonds of the benzene nuclei and the chain. A. C. M.

535.375.5

3896. Raman spectra of alkali halides. MENZIES, A. C. AND SKINNER, J. *J. Phys. Radium* (*Sér.* 8) **9**, 93–8 (*March*, 1948) *In French.*—Raman spectra of second order are observed in NaCl, KCl and KBr single crystals, and the effects of polarization are noted. The symmetry of these crystals precludes the appearance of the primary vibrations, but the second order (octaves of the primaries) is allowed. This necessitates long exposures, and to observe the polarization of the scattered light would require impossibly long exposures if the incident beam, at right angles to the emergent beam, were well collimated. Owing to refraction in the crystals, which have a moderately high refractive index for the 2 537 Å Hg radiation which was used, the effect of lack of collimation of the incident beam on the polarization is not great enough to prevent some observations being made. NaCl and KBr give spectra which appear like a continuum with peaks, and the strongest of these about 232 and 127 cm^{-1} in the two crystals respectively, have a depolarization in excess of unity. KCl, on the other hand, gives rise to a much weaker spectrum, and has no prominent peak, and all the spectrum seen is polarized. The difference between the two types, NaCl, KBr on the one hand, and KCl on the other, is discussed, and it is suggested that the spectra are strongly influenced by the mass-ratio m/M of the lighter ion to the heavier ion in the different salts. For the first type, m/M is clearly different from unity, while in KCl it is 0·91. When the frequency of vibration, is plotted against ϕ, the phase difference along a chain of atoms between neighbouring like atoms, an optical branch and an acoustical branch are found, with extrema at $\phi =$ If $m/M = 1$, these extrema disappear, and $m/M = 0{\cdot}91$, they are very sharp, so that the corresponding intensity-maxima in the continuum could be very weak. A. C.

535.37

3897. Raman spectrum of trimethyl silicon chlori DUCHESNE, J. Letter in *J. Chem. Phys.*, **16**, 1006 (*O* 1948).—Fifteen vibration frequencies are reported the Raman spectrum of this substance in the liq state. Allocations are made of these frequencies, suitable vibrations of the atoms in the molecule, and particular the following are attributed to the 6 vib tions of the $ClSiR_3$ radical:—760, 187, 637, 8 242 and 330 cm^{-1} respectively for frequencies ν_1 to A simple valency force-field model leads to values reasonable agreement. Corroborative observatio from other compounds are quoted. A. C.

535.37

3898. Raman spectrum of tetraethyl orthosilica DUCHESNE, J. *J. Chem. Phys.*, **16**, 1009–10 (*O* 1948).—This substance contains SiO_4 and C_2 groups and the paper describes the Raman spectr of it in the liquid state, and the frequencies of th groups are discussed. 20 vibration frequencies recorded, and reasons are given for the identificat of them with various vibrations of the molec 651, 236, 1 087 and 280 cm^{-1} are allocated to ν_1, ν_3 and ν_4 respectively of the SiO_4 group, and th satisfy a valence model, in which the stretching deformation force constants are respectively 5 $0{\cdot}2\times10^5$ deg/cm. A. C.

535.37

3899. Raman spectra of acetals. LITTLE, M. H. A MARTELL, A. E. *J. Phys. Coll. Chem.*, **53**, 472 (*April*, 1949).

535.37

3900. The infra-red and Raman spectra of chlo trifluoride. JONES, E. A., PARKINSON, T. F. A MURRAY, R. B. Letter in *J. Chem. Phys.*, **17**, 50 (*May*, 1949).

535.37

3901. The infra-red and Raman spectra of carb fluoride. WOLTZ, P. J. H. AND JONES, E. A. Le in *J. Chem. Phys.*, **17**, 302 (*May*, 1949).

535.37

3902. The interpretation of the vibrational spe of the C_6 hydrocarbons 22-dimethyl butane, dimethyl-3-butene, and 22-dimethyl-3-butyne. SH PARD, N. *J. Chem. Phys.*, **17**, 455–60 (*May*, 1949)

535.375.5 : 539.133

3903. Polarization of Raman lines of *s*-dichloroethane. NEU, J. T., OTTENBERG, A. AND GWINN, W. D. Letter in *J. Chem. Phys.*, **16**, 1004–5 (*Oct.*, 1948).—The polarization data available on 123 cm^{-1} and 1 206 cm^{-1} Raman displacements of *s*-dichloroethane are conflicting and experiments have been repeated for these as well as for all other Raman displacements. The ascertained data show that the high energy form of the molecule is C_2, not C_{2v}. W. R. A.

535.375.5 : 539.133

3904. Raman frequencies of *n*-paraffin molecules. MIZUSHIMA, S. AND SIMANOUTI, T. *J. Amer. Chem. Soc.*, **71**, 1320–4 (*April*, 1949).—The disappearance of many Raman lines of *n*-paraffins on solidification has been explained by considering only one molecular form in the solid state and several ones in the liquid state. The molecular form in the solid state has been shown to be the extended form for which the calculation of normal vibrations has been made. A short discussion on high elasticity has been added. A.

535.375.5 : 548.0

3905. Raman spectra of mixed crystals: sodium and potassium nitrates. RAJU, M. K. *Proc. Indian Acad. Sci. A*, **22**, 150–6 (*Sept.*, 1945).

535.375.54

3906. Study by Raman effect, of effect of crystal field on a complex ion. COUTURE, L. *J. Phys. Radium* (*Sér.* 8) **9**, 84–7 (*March*, 1948) *In French.*—A theoretical and experimental study of the Raman spectrum of anhydrite reveals that the vibrations of the SO_4 ion are perturbed by the neighbouring Ca ions. In anhydrite the translational unit cell contains two SO_4 ions only, symmetrically placed with respect to a centre of symmetry. The local symmetry of an ion is C_{2v}, which causes all degeneracy in the free ion to be resolved, so that the vibrations of the SO_4 ion in the crystal result in 9 singlet frequencies. The relative intensities of the lines are calculated by finding the polarizability tensors. The expectations as regards numbers of vibrations, types, and relative intensities are borne out by the experiments. The magnitudes and the senses of separation of the resolved components of the vibrations degenerate in the free SO_4 ion, are explained by the situation of the Ca ions surrounding the SO_4 ions. A. C. M.

535.375.54

3907. Raman spectrum of single crystal of benzene. FRÜHLING, A. *J. Phys. Radium* (*Sér.* 8) **9**, 88–91 (*March*, 1948) *In French.*—The Raman spectrum was obtained for a large single crystal of benzene. The lines found in the spectrum of the liquid were observed, as well as 4 wider lines at 35, 60, 70 and 100 cm^{-1}. Polarization indicated that the lines at 60 and 100 cm^{-1} are due to rotational oscillations in the crystal lattice, while 35 and 70 cm^{-1} have a total-symmetric character. A. C. M.

535.375.54

3908. Effect of temperature on low frequency Raman lines in sodium nitrate. VASSAS-DUBUISSON, C. *J. Phys. Radium* (*Sér.* 8) **9**, 91–2 (*March*, 1948) *In French.*—In sodium nitrate there is a transformation-point at about 275°C. As the temp. is raised, the lines at 100 and 190 cm^{-1} widen, decrease in frequency, and they get weaker and disappear at the transformation temp. At about 200° the Rayleigh line increases considerably. The observations were made on a crystal grown from the melt, heated subsequently in an electric furnace; in a second experiment the spectrum was taken of the molten material, then the crystal was grown in situ in the light-scattering apparatus, and another spectrum taken at 300°. It is concluded that the 2 frequencies are due to a translational vibration, and a rotational oscillation of the NO_3 groups; at the transition-point a free rotation of the NO_3 groups sets in around the ternary axis. A. C. M.

535.375.54 : 536.631

3909. Thermal agitation in organic crystals. ROUSSET, A. *J. Phys. Radium* (*Sér.* 8) **9**, 101–4 (*March*, 1948) *In French.*—The Raman lines of low frequency in organic molecules are attributed to rotational oscillations of the molecule ("pivotements") about the principal axes of inertia. In calculating the specific heat of such crystals at low temperatures, one can assume the molecules to act as rigid, for the internal frequencies of the molecule correspond to a Debye temp. of the order of 350°. The thermal agitation can then be thought of as (1) a system of elastic waves which takes account of movements of the centre of gravity of the molecule, and (2) a system of elastic waves which takes account of rotations of the molecules around the centre of gravity, supposed fixed. The latter is taken into account as Einstein functions corresponding to frequencies given by the Raman effect. In this way curves are calculated for the variation of specific heat with temp. at low temps. for napthalene and benzene, and comparison with the experimental curves suggests that rotational oscillations account for the thermal agitation almost exclusively. A. C. M.

535.39

3910. Optical determination of thin films on reflecting bases in transparent environments. WINTERBOTTOM, A. B. *Proc. Pittsburgh Internat. Conf. Surface Reactions*, 91–100 (1948).—The classical theory of metal and film optics is recapitulated, and its implications in connection with various optical methods of studying films and surfaces are indicated. The experimental technique of the determination of thin films in situ from the change produced in the reflection of a polarized wave is then outlined. Optical techniques are not advocated to supplant other methods of studying surfaces such as weight increment, gas absorption, electron diffraction, X-ray diffraction, and electrochemical analysis, but rather to supplement these in selected cases. In particular, the optical techniques are of value in making continuous studies of films in situ in transparent environments when conditions render the application of other methods difficult. Examples of applications are given. M. A.

535.39

3911. Anti-reflection coating of glass surfaces. HIESINGER, L. *Optik*, **3** (*Nos* 5–6) 485–94 (1948) *In German.*—The technique of reducing reflection at optical interfaces must take into account not only the optical properties but also the stability and ease of production of the coatings. The necessary condition

for suppression of reflection in a single homogeneous film cannot technically be fulfilled and those for 2, 3, 4 . . . films are deduced. Residual reflection of wavelengths near the critical valve can be reduced to a minimum by suitable choice of refractive index for the coatings. A. HU.

535.39

3912. Increase of reflection from glass by coating with metallic oxides. HAMMER, K. *Optik*, **3**, (*Nos* 5–6) 495–8 (1948) *In German.*—The reflectivity, transmissivity, colour by transmission and refractive index of $\lambda/4$ layers of 14 metallic oxides deposited on glass by evaporation or sputtering are tabulated and discussed. Oxides of Si, Fe and Cu yield semi-reflecting layers with only 6–8% absorption, as compared with up to 40% in metallic films. A. HU.

535.417 : 522.613

3913. High intensity reflection interferometry for weak sources. TOLANSKY, S. AND RANADE, J. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1) 86–93 (1949).—The high resolution of the Fabry–Pérot interferometer is retained without the usual heavy loss of light by employing reflection fringes. Practically no loss of intensity is involved, but absorption in the semi-reflecting film reduces the visibility of the fringes. The reflection fringes are complementary to the familiar transmission fringes, except that absorption "dilutes" the dark fringes. The best visibility results from making the front mirror of low (75–80%) reflectivity, but the back mirror opaque (95%). Applications are indicated to precise wavelength measurements and line-width determinations in astrophysical sources. A. HU.

535.417 : 535.32.08

Refraction investigations with the Mach–Zehndev interferometer. *See Abstr.* 3859

535.434

3914. Light scattering by colloidal particles oriented by ultrasonics. BÖMMEL, H. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 289–98 (1948) *In German.*—Light scattered by a WO_3 sol with and without ultrasonic irradiation differs in intensity especially at small angles of scattering, whereas no such effect is shown by water or by agar-agar sols. It has further been demonstrated that the reflected light shows the identical behaviour. These data suggest—and electron microscope photographs prove—that the particles are of different magnitude and general form. W. R. A.

535.514

3915. Polarization of light passing through metal slits. THIESSEN, G. *Himmelswelt*, **55** (*Nos* 3–4) 72–3 (1948) *In German.*—Experimental and theoretical treatment of light passing through a narrow but relatively deep metal slit: the light becomes partially polarized, and this effect is the greater, the narrower the slit and the longer the wavelength. It is noted that spectrophotometric work should avoid such deep metal slits which in themselves could falsify changes in the true intensity distribution. A. B.

535.514.4 : 535.39

3916. Production of plane polarized light by thin dielectric films. SCHRÖDER, H. *Optik*, **3**, 499–503 (*July–Aug.*, 1948) *In German.*—Unpolarized light may be completely plane polarized for every angle of incidence by reflection from thin absorption-fr films, the reflected intensity increasing with t refractive index of the film. The latter must be suit to the angle of incidence. As, moreover, the degr of polarization of the transmitted light increases wi this, the effect of a set of uncovered glass plates m be considerably surpassed.

535.514

3917. Anomalous polarization of light scattered crystals. BARRIOL, J. AND FRÜHLING, A. *J. Phy Radium* (*Sér.* 8) **9**, 98–100 (*March*, 1948) *In French.* The theory of Placzek would require for the sy metrical vibration of the CO_3 ion in the carbonate a depolarization zero, resulting from the tensor polarizability being a diagonal one. On the oth hand, in certain cases experimentally investigat the value found is 0·3. Analogous results have be got for a crystal of benzene by Frühling [see Abs 3907 (1949)] in respect of the total symmetric vibr tions 992 and 3 062 cm^{-1}. Two causes are suggeste (*a*) that it is due in these orthorhombic crystals to t influence of the two vectors of propagation of t incident and scattered radiations, and (*b*) that it brought about by the interaction of the elastic wa vibrations in the crystal with the internal vibratio of the ion or molecule. A. C.

535.514.9 : 535.3

The cellulose dye complex and its application as lig polarizer. *See Abstr.* 3882

535.5

3918. Theory of a modification of the method J. MacCullagh and G. G. Stokes for the analysis elliptically polarized light in the special case of elongated vibration ellipse. BEREK, M. AND MARX, *Optik*, **3**, 444–50 (*July–Aug.*, 1948) *In German.*—T original MacCullagh–Stokes method, in whi analysis of an elliptical vibration was carried out using a rotatable mica plate compensator of unkno phase difference in conjunction with an analyser, h been modified, for the case of an elongated vibrati ellipse, so as to reduce the number of readings nec sary to determine the azimuth ψ and the ellipticity The modification requires a knowledge of the pha difference of the compensator plate. Details are giv of the range of measurement and the best measuri conditions. Simple relations are derived betwe ψ, θ and the azimuths of the compensator a analyser when in adjustment. The best value for t path difference of the compensator is given as λ which is derived from consideration of the intens of the light emerging from the analyser. Improv ments recently suggested [Turner, Benford, McLea *Econ. Geol.*, **40**, 18–33 (1945)] to a method of Ber [*Optik*, **2**, 332–41 (*Oct.–Nov.*, 1947); *Fortschr. d. M Krist. u. Petr.*, **22** (*Pt* 1) 20–34 (1937)]; are criticized. H. G.

535.55 : 539.4.014

The determination of the separate stresses by t frozen stress method. *See Abstr.* 4197

535.5

3919. Photo-elastic behaviour of ammonium alu crystals. BHAGAVANTAM, S. AND SURYANARAYANA, *Acta Cryst.*, **2**, 26–30 (1949) *In English.*—[See Abs 109 (1948), 4256 (1949)]. 4 (not 3) photoelastic co stants are required for the crystal class $2/m3$. T

stress-optical constants are determined as $(q_{11} - q_{12}) = -5{\cdot}93\times10^{-13}$, $(q_{11} - q_{13}) = -5{\cdot}25\times10^{-13}$, $q_{44} = -1{\cdot}15\times10^{-13}$, with errors of $\sim 2\%$. Less accurate values for the individual constants are $q_{11} = 5{\cdot}5\times10^{-13}$, $q_{12} = 11{\cdot}6\times10^{-13}$, $q_{13} = 10{\cdot}9\times10^{-13}$, all in $cm^2\ dyne^{-1}$. A. J. C. W.

535.6.07

3920. Example of metamerism: extreme example of color change with varying illuminant. DEXTER, F. C. AND STEARNS, E. I. *J. Opt. Soc. Amer.*, **38**, 816–17 (*Sept.*, 1948).—An extreme example of colour change when the light is changed from W to daylight is described. Dye formulations and colorimetric specifications are given, and the change is described in terms of a chromaticity diagram. Two materials are instanced which both appear to have the same green colour in daylight, but on changing to tungsten light one stays green while the other turns brown. A. C. M.

535.65

3921. New neutral glasses. CHESTERMAN, W. D. *J. Sci. Instrum. Phys. Ind.*, **26**, 175–6 (*May*, 1949).—The spectral transmissions and colours of recently developed neutral glasses are given. Similar colorimetric properties for glasses that were previously obtainable in this country and in Germany are included for comparison purposes. A.

535.81 : 666.22

3922. Optical glass of interferometer and schlieren quality for wind-tunnel optics. TILTON, L. W. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 279–86 (*March*, 1949).—Large discs for wind tunnels should be uniform in optical thickness within $\pm 1/16\lambda$ if highest accuracy in measurements by interference fringes is to be insured. This means that heterogeneities in the glass shall be $< \pm 5\times10^{-7}$ in refractive index for thicknesses of 3 or 4 cm. Evidence is cited to show that differences in chemical composition in good glass may not prevent realization of the desired uniformity, and that stress birefringence cannot be an important preventing factor. The remaining source of non-uniformity in glass is the existence of temp. gradients during annealing that can cause changes in structure, and it has been found that these can be reduced within required limits simply by encasing the glass, during annealings, in a sufficient number of concentric boxes composed of alternately heat-conducting and insulating layers. A.

535.822.5

3923. A compound reflecting microscope of high aperture for use in ultra-violet light. JOHNSON, B. K. *J. Sci. Instrum. Phys. Ind.*, **26**, 148–50 (*May*, 1949).—Compound microscopes are described in which the first magnification is produced by reflection from the back surface of a LiF meniscus lens, followed by a further dioptric magnification through fused quartz hemispherical lenses and a Ramsden form eyepiece corrected for u.v. light. The optical system is so designed that when focused in visible green light it is simultaneously in focus in u.v. light. Specifications are given and tables of the aberrations. The N.A. of the systems are 0·84 and 1·27. A.

535.825

3924. A new tool for infra-red studies. BAILLY, R. *Science*, **108**, 143 (*Aug.* 6, 1948).—Substitution of an electronic infrared image tube for the eyepiece of a polarizing microscope makes it possible to examine otherwise opaque specimens, e.g. stibnite is transparent up to 4 mm thickness. W. R. A.

535.87

3925. Survey of the family of spherically corrected and coma-free two-mirror systems, their residual astigmatism and vignetting. THEISSING, H. AND ZINKE, O. *Optik*, **3** (*Nos* 5–6) 451–74 (1948) *In German.*—The systems considered are restricted to those in which the final image falls at the pole of the first mirror. The paraxial magnification (v) of the second mirror is then used as the parameter of the family. Only first order aberrations are considered, and the deformation of a surface is denoted by b (after Schwarzschild). It is shown that the residual astigmatism is a quadratic function of v, while the paraxial obscuration ratio (vignetting) for an axial image point is given by $\lambda^2 = 1/(v+1)^2$. It is concluded that with this type of system small residual astigmatism entails heavy vignetting and vice versa. The treatment is then generalized to meet the case of an arbitrarily placed image plane. Comparison with a Goertz double anastigmat by ray tracing showed the mirror system to have astigmatism $\gtrsim$ the anastigmat if the field is restricted to $\pm 10°$. A comparison with the single parabolic reflector indicated that up to 2° angular field the latter was to be preferred, although its coma was ignored. H. H. HOP.

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536.212.2

3926. A problem relating to heat conduction in solids. III. PUSHKIN, V. S. *J. Tech. Phys.*, **18**, 1044–50 (*Aug.*, 1948) *In Russian.*—The form and motion of the liquid-solid interface in a homogeneous isotropic solid being melted by a localized heat-source on its surface are considered. Heat transfer is assumed to be entirely due to conduction; convection is neglected. The necessary conditions for similarity between the above system and a model consisting of a semi-infinite cylinder heated at one end and having a thermally-insulated curved surface are established by dimensional analysis. These conditions being known, experimental measurements on the model can be used to predict the behaviour of the system under consideration. No experimental data on the model are given. A. SCH.

536.412.08

3927. Measurement of thermal expansion. Review of methods for liquids. EBERT, H. *Arch. tech. Messen* (*No.* 159) *Ref. V*9221–1, *T*11–12 (*Jan.*, 1949) *In German.*—A general survey with 18 references.

536.413 : 539.319

The stresses in bimetals. *See Abstr.* 4189

536.42 : 536.48

3928. Transition points. ONSAGER, L. AND KAUFMAN, B. *Rep. Internat. Conf. "Low Temperatures"* (1946) (*Phys. Soc., Lond.*) **II**, 137–44 (1948).—Phase changes in which properties change continuously with the temperature are considered in terms of a generalized

Ising model. The theory of spinors is used to calculate the partition function, and it is shown that the specific heat has a singularity at the transition point.

A. E. De B.

536.421.48 : 551.578.4

Nucleation of supercooled water clouds by silver iodide smokes. *See Abstr.* 4328

536.421.48 : 551.578.4

The formation of ice crystals in the laboratory and the atmosphere. *See Abstr.* 4329

536.422.15 : 536.654

3929. The vapour pressure and heat of sublimation of graphite. Long, L. H. Letter in *J. Chem. Phys.*, **16**, 1087 (*Nov.*, 1948).—The experimental results of several other workers are quoted as evidence that graphite possesses a higher vapour pressure and consequently lower heat of sublimation than those recently reported [Abstr. 2469 (1949)]. S. W.

536.423 : 551.578.4

3930. Condensation in water vapour below 0°C. Fournier d'Albe, E. M. Letter in *Nature, Lond.*, **162**, 921–2 (*Dec.* 11, 1948).—Cloud particles in adiabatic expansions below 0°C were studied, particularly as regards the formation of ice crystals by direct sublimation or by freezing of initially condensed water drops. In clean air and with expansion up to 1 : 10 little condensation was observed down to −55°C; with outdoor air or contaminated air, intense formation of ice crystals below −41°C was observed. A single specific example of contamination leading to direct sublimation is described. J. G. W.

536.423.15

3931. Vapour pressure and phase separation of high molecular solutions. Jenckel, E. *Z. Naturforsch.*, **3a**, 290–8 (*May*, 1948) *In German.*—V.p. measurements with curves are recorded for various high molecular solutions over an extended concentration range. The systems polystyrene-α-picolin, polystyrene-toluene, and polymethacrylester-α-picolin, exhibit deviations from ideal vapour pressure behaviour between 0–70 g-mol %. The critical point for separation into phases has been determined for polystyrene-octadecyl alcohol and for other compounds of varying chain lengths. The critical composition corresponds to a very dilute solution, and the critical temp. rises only slightly with the degree of polymerization. The Ostwald extrapolation formula for infinite dilution is found to follow from the v.p. curves. H. H. Ho.

536.423.15

3932. Maxima in vapour pressure curves. Korvezee, A. E. and Dingemans, P. *J. Amer. Chem. Soc.*, **70**, 2818 (*Aug.*, 1948).—Vapour pressure curves of soluble salts exhibit maxima (T_{max}), the location of such maxima being related to the m.p. (T_s) of the salt by the expression $1/T_{max} = 1/T_s + 0{\cdot}00021$. W. R. A.

536.423.15

3933. The vapor pressure of nitrosyl chloride. Partington, J. R. and Whynes, A. L. *J. Phys. Coll. Chem.*, **53**, 500–5 (*April*, 1949).

536.46

3934. On the agreement between the theoretical and experimental conditions for a combustion with high air dilution. Reingold, L. *C.R. Acad. Sci., Paris*, **226**, 1254–5 (*April* 19, 1948) *In French.*—A continuation of *C.R. Acad. Sci.*, **226**, 322–4 (*Jan.* 26, 1948). The assumptions made in the theoretical study are shown to be in accord with experimental conditions. S. W.

536.46

3935. On the theory of the propagation of deflagrations. Manson, N. *C.R. Acad. Sci., Paris*, **227**, 720–2 (*Oct.* 11, 1948) *In French.*—For deflagration of gaseous mixtures contained in cylindrical tubes the phenomena, occurring when the deflagration and the disturbances (likened to shocks of feeble amplitude), which are due to the reflections of the initial disturbance (*chasse préalable*) at the ends of the tube meet, are investigated theoretically. [See *C.R. Acad. Sci., Paris*, **226**, 69, 163 and 230 (1948)]. S. W.

536.46 : 531.57

On the burning of powder. *See Abstr.* 3779

536.46 : 541.12

The structure of the reaction zone in a flame. *See Abstr.* 4212

536.46

3936. The structure of ascending H_2–O_2 flames. Böhm, G. and Clusius, K. *Z. Naturforsch.*, **3a**, 386–91 (*July*, 1948) *In German.*—Details of flame structure were shown by addition of vapours which on heating produce solid decomposition products. These greatly intensify light emission from the reaction zone. Chromyl chloride was mainly used; nickel carbonyl was tried, but its use was discontinued owing to its catalytic effect and explosive hazards. Combustion tubes were 5 cm and 10 cm dia. and about 1 m long. Density, thermal conductivity and mol. wt. of the gas mixture were altered by addition of CO_2, SO_2, $SiCl_4$ and SF_6, and by pressure-variation. In general the flame-front does not completely fill the tube cross-section. The reaction-zone for oxidant-rich H-air mixtures near the limit of ignition is a paraboloid, convex upwards, with particularly intense reaction in a few narrow filaments. When about 80% of the oxidant is SO_2 the reaction-zone consists of separate flamelets. For other mixtures a combination of these structures is observed. An approximate relation between number of flamelets and tube dia. is derived. It is shown that vertical motion of the flamelets is a turbulent process. A. Sch.

536.46

3937. Measurement of flame-temperature by means of photoelectric spectrometry. Kandyba, V. V. *Izv. Akad. Nauk, SSSR*, **12** (*No.* 4) 387–91 (*July–Aug.* 1948) *In Russian.*—The intensity of Na resonance radiation emitted from flames containing between $0{\cdot}16\times10^{-3}$ and $0{\cdot}37\times10^{-3}$ gm Na per litre of gas-air mixture was investigated. The flame temp. was kept constant at 1 800°C and the thickness of the flame varied between 7 and 170 mm. A monochromator with a variable slit-width was used to select a narrow spectral band from the emitted radiation and the intensity of this band was measured photoelectrically. For slit-widths $\leqslant 0{\cdot}2$ mm saturated radiation was obtained from flames 30–40 mm thick; for slit-widths $\geqslant 0{\cdot}5$ mm saturation did not occur at thicknesses < 170 mm. This effect of slit-width is attributed to the fact that the emitter concentration required for saturation increases with the width of

spectral band examined. A similar method using an optical filter in place of a monochromator was tested and found unsatisfactory; the defect of this method is believed to be the relatively wide spectral band transmitted by optical filters. A. SCH.

536.48

3938. Some experiments on magnetic thermometry and heat conductivity of chromium potassium alum and glass at low temperatures. BIJL, D. *Physica, 's Grav.*, **14**, 684–93 (*Feb.*, 1949) *In English.*—Experiments on the conduction of heat in potassium chromic alum at liquid He temps., carried out with a magnetic method of measuring temp. are described. It is found that the heat conductivity depends on the velocity with which the substance was cooled down. The same method of measuring temps. is used for the determination of the conductivity of heat of 4 kinds of glass at liquid He temps. A.

536.48

3939. Surface films of liquid He II. DE BOER, J. *Rep. Internat. Conf. "Low Temperatures"* (1946) *Phys. Soc., Lond.*, **II**, 32–5 (1948).—See Abstr. 3514 (1947).

536.48

3940. Frictionless transport. MENDELSSOHN, K. *Rep. Internat. Conf. "Low Temperatures"* (1946) *Phys. Soc., Lond.*, **II**, 35–41 (1948).—Discussion of the flow of phenomena of He II on the basis of the model of 2 phases in momentum space [Abstr. 108, 758–9 (1939)] elaborating the views given in Abstr. 3016 (1945). Stress is laid on the importance of the zero-point momentum for the kinetics of the superfluid transport. The width of the energy gap between the two phases in momentum space is related to the decrease in kinetic energy which occurs when the condensed atoms are no longer localized within a distance of order of the mean free path. See also Abstr. 1309, 2326 (1946). H. L.

536.48

3941. The thermomechanical effects in He II. MELLINK, J. H. AND MEYER, L. *Rep. Internat. Conf. "Low Temperatures"* (1946) *Phys. Soc., Lond.*, **II**, 43–7 (1948).—See Abstr. 2874–5 (1947).

536.48

3942. Remarks on the superfluid flow of liquid He II. LONDON, H. *Rep. Internat. Conf. "Low Temperatures"* (1946) *Phys. Soc., Lond.*, **II**, 45–52 (1948).—Reasons are given which make it unnecessary to assume that the superfluid flow is localized at the walls, and some experimental evidence is quoted in support of the Tisza–Landau hydrodynamics which postulates potential flow for the superfluid phase. The question is asked whether this potential flow is incidental to the absence of friction or an intrinsic property of the degenerate phase. A crucial experiment is suggested which consists in rotating a container filled with He I and cooling it afterwards below the λ-point. If the superfluid flow is essentially non-rotational, a change in angular momentum on cooling would be observed. Such a behaviour would bring the properties of He II in line with superconductors. The relation of this change in angular momentum to the Meissner effect of superconductors is discussed. It is recommended to carry out the experiment at angular velocities $< \hbar/2ma^2$ (m = mass of the He atom, a = radius of container), because it is believed that the pure superfluid flow is confined to flow rates < the critical rate given by Bijl, de Boer and Michels [Abstr. 3514 (1947)]. H. L.

536.48

3943. Some speculations on the constitution of He II. REEKIE, J. *Rep. Internat. Conf. "Low Temperatures"* (1946) *Phys. Soc., Lond.*, **II**, 52–5 (1948).—Discussion of the flow phenomena of He II on the basis of the model of 2 phases in momentum space [Abstr. 108, 758–9 (1939), 3016 (1945)]. It is pointed out that the wave function of the degenerate atoms extends uniformly over the whole volume of the liquid and that therefore every degenerate atom occupies in effect the whole of the available volume. If, by supply of heat, atoms are raised into excited levels, a flow of the degenerate atoms towards the heat source has to take place in order to maintain the uniformity of the wave function. It is further assumed that in very narrow channels and in liquid He films the He consists practically entirely of degenerate atoms. The formation of the films is considered to be due to unavoidable temperature gradients which pull the He upwards by the fountain effect. Because of the vanishing viscosity the film is replenished as fast as it evaporates. H. L.

536.48

3944. Theory of viscosity of liquid helium II. LANDAU, L. D. AND KHALATNIKOV, I. M. *Bull. Acad. Sci., URSS, Sér. Phys.*, **12** (*No.* 3) 216 (1948) *In Russian.*—The viscosity of liquid helium II is considered (on the basis of Landau's theory) as consisting of a roton and a phonon part. The former depends mainly on elastic scattering of rotons by rotons and is independent of temp., while the latter depends above 0·8°K mainly on scattering by rotons, giving a contribution $\propto \varepsilon^{\Delta/T} T^{-\frac{1}{2}}$, and below 0·8°K mainly on phonon-phonon scattering, giving a contribution $\propto T^{-5}$ ($k\Delta$ is the energy gap between the lowest levels of phonons and rotons). These predictions are in good agreement with experimental results by Andronikashvili [Abstr. 3946 (1949)]. D. S.

536.48 : 531.756

3945. Temperature dependence of the normal density of helium II. ANDRONIKASHVILI, E. L. *J. Exp. Theor. Phys., USSR*, **18**, 424–8 (*May*, 1948) *In Russian.*—From the variation of the moment of inertia of a shutter-like arrangement of light discs, parallel to each other and submerged in He II, the temp. dependence of the density of its normal component was determined in the interval from the λ-point down to 1·34°K. The depth of penetration into He II of a viscous wave at various temps. was also observed. A.

536.48 : 532.133

3946. Investigation of the viscosity of the normal component of helium II. ANDRONIKASHVILI, E. L. *J. Exp. Theor. Phys., USSR*, **18**, 429–33 (*May*, 1948) *In Russian.*—From the observation of the damping of axial torsional oscillations of discs the viscosity of the normal component of He II was measured in the interval between the λ-point and 1·32°K. The independence of the viscosity of the roton gas from

temp. far from the λ-point was established, and the value of the effective scattering cross-section of the rotons was found. In the low temp. range a steep increase of the viscosity of the normal component was found which seems due to the lengthening of the free path of the phonons. A.

536.48 : 532.7

3947. The present state of the theory of liquid He. LONDON, F. *Rep. Internat. Conf.* "*Low Temperatures*" (1946) *Phys. Soc., Lond.*, **II**, 1–18 (1948).—Low temperature transfer is considered as a quantum mechanism of macroscopic scale. From the uncertainty principle it follows that particles of low mass and weak interaction forces have minimum total energy at a distance considerably > that required for minimum potential energy. In their lowest state they may not even be localized in a lattice [Abstr. 770 (1936)]. The state of order at absolute zero is realized by sharp localization in momentum space. In ordinary space the system has to be described by a common wave function extending over the whole volume, which cannot be split into wave packets. This omnipresence of the particles brings an entirely new element into consideration which will have to be dealt with in the future quantum hydrodynamics. The model of the ideal Bose–Einstein gas is introduced as working hypothesis for the study of the properties of superfluid helium. B.–E. particles of the atomic mass of He and at the density of liquid He begin to assemble in the lowest energy state in momentum space at a temperature near the λ-point of He, thus giving the model of two phases in momentum space in which a certain fraction of the atoms is concentrated in the lowest state with zero entropy while the remainder is distributed over a great number of excited states [Abstr. 108 (1939)]. A particular feature of B.–E. statistics is that the "relative density," which is referred to the surroundings of any given molecule as centre, differs from ordinary density [Abstr. 1901 (1943)]. From this, taking account of interaction forces, a negative thermal expansion coefficient can be obtained, which is one of the peculiarities of He II. Tisza's model of He II [Abstr. 758, 759 (1939), 252 (1948)], which is obtained by postulating non-viscous flow for the phase of zero entropy, is explained. This leads to the mechanocaloric and thermo-mechanical effects, the abnormal heat conductivity, the second sound and to the complete thermo-hydrodynamics of Landau [Abstr. 2532 (1942)]. The quantum hydrodynamics of Landau (l.c.) are criticized, and a commutation rule for the momentum density vector is given [Abstr. 776 (1946)]. The hypothesis that the superfluid flow is essentially irrotational [H. London, Abstr. 3942 (1949)] and the resulting parallelism with superconductivity are explained. Finally the expression for the critical transfer rate [Bijl, de Boer and Michels, Abstr. 3514 (1947)] is discussed. This expression, which possibly also applies to superconductors [Abstr. 776 (1946)] is another indication of the quantum-mechanical nature of the superfluid and superconducting transport phenomena. H. L.

536.48 : 532.7

Thermodynamic pressure of a quantum liquid. *See Abstr.* 3803

536.48 : 534.2

3948. Determination of the velocity of propagatio of the second sound in He II. PESHKOV, V. *Re Internat. Conf.* "*Low Temperatures*" (1946) *Phy Soc., Lond.*, **II**, 19–32 (1948).—Extension of th experiments [Abstr. 614 (1947)]. Detailed descriptio of the arrangement for the detection of both pr propagating and standing temperature waves. Data a given of the propagation velocity between 1·36° an 2·184°K, showing a maximum at 1·6°K. The result are discussed on the basis of Landau's hydr dynamics [Abstr. 2532 (1942)] and the concentratio of the normal phase in the two-phase model ca culated, in good agreement with the results Andronikashvili obtained by the oscillating dis method [Abstr. 321 (1947)]. H. I

536.48 : 534.2

3949. Second sound in helium II at elevated pressure PESHKOV, V. P. AND ZINOVYEVA, K. N. *J. Ex Theor. Phys., USSR*, **18**, 438–43 (*May*, 1948) *Russian.*—The velocity of propagation of secon sound was measured over the whole range of existenc of He II at temps. from 1·3°K to the λ-line. Th transition curves from He II into He I and heavy H were determined. A

536.48 : 534.2

3950. Pulsed second sound in liquid helium I PELLAM, J. R. Letter in *Phys. Rev.*, **74**, 841 (*Oct.* 1948).—Extension of measurements [Abstr. 88 (1948)] to the second sound. The velocity agree with the results of earlier workers who used standin waves. The attenuation coefficient for 150 μ-se pulses is 10^{-2} cm^{-1} at 1·65°K and 10^{-1} cm^{-1} at 2·06° and then rises rapidly as the λ-point is approache Lifting the receiver above the surface of the liqui temp. pulses were observed in the vapour phas indicating that about 5% of the second soun intensity is converted into vapour sound intensity First sound originating from a second sound sourc was observed and also secondary second soun peaks which are attributed to a double conversion second → first → second sound. See also Osborn [Abstr. 3745 (1948)]. H. I

536.48 : 536.2

3951. Experiments on the formation of the He film MENDELSSOHN, K. *Rep. Internat. Conf.* "*Lo Temperatures*" (1946) *Phys. Soc., Lond.*, **II**, 41– (1948).—Measurement of the heat transfer due to H films formed on a number of tubes suspended fro the roof of a closed container and ending at a certai distance above its bottom. The heat transfer i increased when the level of He II in the containe reaches the suspended tubes, the increase corre sponding to the additional surface offered to the film by the suspended tubes. H. I

536.5.08

3952. The International Temperature Scale of 1948 STIMSON, H. F. *J. Res. Nat. Bur. Stand., Wash.*, **42** 209–17 (*March*, 1949).—The International Tempera ture Scale is based upon 6 fixed and reproducibl equilibrium temps. to which numerical values hav been assigned and upon specified interpolatio formulae relating temp. to the indications of specifie measuring instruments. This is the first revision o

the scale adopted in 1927. It is designed to conform as nearly as practicable to the thermodynamic centigrade scale as now known, while incorporating certain refinements based on experience to make the scale more uniform and reproducible than its predecessor. A new value for the temperature of the silver point and the use of Planck's law with a new value for the radiation constant, c_2, are the only changes which produce significant effects on numerical values assigned to temps. A.

536.53

3953. Dynamic impedance and sensitivity of radiation thermocouples. FELLGETT, P. B. *Proc. Phys. Soc., Lond. B*, **62**, 351–9 (*June*, 1949).—The concept of dynamic impedance is applied to radiation thermocouples. An equivalent circuit is derived, in terms of which the working of a thermocouple and the factors leading to high sensitivity can be visualized. Methods are given for measuring the dynamic impedance and it is shown that these measurements lead to values for thermoelectric power, heat loss from the receiver, and time constant of the thermocouple. Expressions are given, in terms of the dynamic impedance, for the important properties of radiation thermocouples, namely the signal-to-noise sensitivity, ultimate sensitivity, noise factor and power efficiency. These properties are thus obtained in terms of parameters that can be predicted from the design, or measured in the finished instrument. The sensitivity is found without recourse to micro-measurements and therefore independent of limitations set by the thermocouple amplifier. The expression for sensitivity differs from those previously published, and the discrepancy is discussed. The way in which the ultimate sensitivity might be approached in practice is indicated. The efficiency is shown to depend on the amount of radiation falling on the receiver of the thermocouple, but to be a constant fraction of the thermodynamic limit $\Delta T/T$. For an ideal thermocouple the fraction is $\frac{1}{2}$, for an actual thermocouple it is less by a factor known as the relative efficiency. A.

536.532

3954. A six-point, high-speed, thermocouple temperature-recording equipment. WATSON, J. D. AND DIXON, H. E. *J. Sci. Instrum. Phys. Ind.*, **26**, 17–18 (*Jan.*, 1949).—The instrument described provides a means of recording the signals from 6 independent thermocouples on a single pen-recorder chart by consecutively switching the thermocouple points into a standard d.c. amplifier and pen-recorder equipment. An electrically operated marker pen is added to the recorder to permit time correlation between the thermocouple records and the instant of taking any other records involved in a particular experiment. A.

536.587

3955. The theory of temperature control. EGGERS, H. R. *Elektrotech. Z.* [*ETZ*] **69**, 329–32 (*Oct.*, 1948) *In German.*—The theory is developed for the case when a timing device is included in the controlling element so that a temp. variation curve is established about the control point. Good agreement with experiment is shown. E. H. D.

536.63

3956. Specific heats of manganese and bismuth at liquid hydrogen temperatures. ARMSTRONG, L. D. AND GRAYSON-SMITH, H. *Canad. J. Res. A*, **27**, 9–16 (*March*, 1949).—New measurements in the range 14° to 22°K are reported. The specific heats of these metals are compared with theory. In both cases the approx. theoretical formula $C_v = C_D(T/\theta) + AT$, where $C_D(x)$ is the Debye function, is accurately obeyed over the limited temp. region concerned. However, comparison with measurements at other temps. shows that this may lead to erroneous conclusions. For Mn a precise conclusion is not possible, and it is estimated that the electronic specific heat coefficient A lies between 0·0035 and 0·0040, while θ varies with temp. from 365 to 390 deg. For Bi it is concluded that the electronic specific heat is negligible. This permits an accurate determination of θ, and it is found that the variation of θ with temp. is remarkably similar to that predicted by Blackman for a simple cubic lattice. A.

536.63.08

3957. Simple calorimeter for measuring specific heat. RICE, R. B. *Gen. Elect. Rev.*, **51**, 32–6 (*Oct.*, 1948).—A calorimeter, useful for the rapid determination of specific heats of powdered solids and liquids, and consisting essentially of a silvered dewar flask, a nichrome heating coil suspended within the flask, and a glass stirrer driven by a constant-speed motor, is described. The heat input, measured in terms of the electrical energy required to produce a measured rise in temp. of the calorimeter + contents, is supplied electrically through the coil. The powdered specimens are suspended in a contact liquid within the flask. The thermal capacity of the calorimeter was determined using CCl_4 of known specific heat. As contact liquids, for a test on aluminium oxide (Al_2O_3), CCl_4 and a mixture of CCl_4 and bromoform were used. S. W.

536.631 : 535.375.54

Thermal agitation in organic crystals. *See Abstr.* 3909

536.632

3958. The measurement of the specific heats of some organic liquids using the cooling method. LEECH, J. W. *Proc. Phys. Soc., Lond. B*, **62**, 390–8 (*June*, 1949).—The cooling method for the determination of the specific heats of liquids is further developed. The power law of cooling, $d\theta/dt = k\theta^n$, is shown to hold only approximately, and a new method for deducing values of $d\theta/dt$ is described. The specific heats of a number of liquid carbinols are measured over the approximate range 40–70°C. A.

536.662

3959. Heats of combustion and isomerization of the six C_7H_{14} alkylcyclopentanes. JOHNSON, W. H., PROSEN, E. J. AND ROSSINI, F. D. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 251–5 (*March*, 1949).

THERMODYNAMICS 536.7/.8

536.7

3960. Remarks on a thermodynamic equation derived from Clapeyron's equation. JAFFRAY, J.

Cah. de Phys. (*No.* 33) 17–24 (*Oct.*, 1948) *In French.*—By differentiation of Clapeyron's equation with respect to the temperature an equation giving the rate of variation of the latent heat in terms of the specific heats at constant pressure and expansion coefficients of the two phases is obtained. The application to special cases is discussed. Applying the equation to transformations of the second order, the three equations of Ehrenfest for such transformations are readily deduced. F. E. H.

536.71

3961. Search for the equation of state for matter. MILOSAVLIEVITCH, D. *Bull. Soc. Chim., Belgrade* (*No.* 4) 221–40 (1947).—See Abstr. 611, 2115 (1948).

536.75

3962. Treatment of non-equilibrium conditions with the aid of a limiting value principle. KOHLER, M. *Z. Phys.*, **124** (*Nos* 7–12) 772–89 (1948) *In German.*—The methods of classical kinetic gas theory for the determination of the transport constants are shown to be consistent with the procedure of Ritz. The fundamental equations of equilibrium are incorporated in a variation principle—the maximum principle of entropy increase of Enskog—and the minimum principle of entropy increase. The variation of entropy increase with steadily maintained heat flow and steadily maintained viscous stress is carried out, and it is proved that the application of the Ritz process leads to the equations obtained by the Enskog and Burnett methods. In the case considered the entropy increase function is itself a minimum. The same process can in like manner be applied to the problem of determining the transport constants in an electron gas in a metal. G. G.

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.112 : 778.3

3963. Range-energy and other relations for electrons in Kodak nuclear plates. ROSS, M. A. S. AND ZAJAC, B. Letter in *Nature, Lond.*, **162,** 923 (*Dec.* 11, 1948).—The range-energy relationship has been determined, using a β-ray spectrograph with magnetic deflection, the electrons falling on the plates at glancing incidence. The mean grain density along the tracks and the stopping power have also been measured. The stopping power varies to some extent with the energy of the electrons; it is of the order of 3 000 times that of air. W. F. B.

537.12 : 538.1 : 530.14

3964. On the motion of point electrons. HABER-SCHAIM, U. Letter in *Phys. Rev.*, **74,** 836–7 (*Oct.* 1, 1948).—The generalized Lorenz equations of motion of an electron discussed by Eliezer [Abstr. 32 (1948)] are obtained by adding a non-divergent tensor to the energy-momentum tensor of the Maxwell field. The contribution to the self-energy then depends on the past history of the particle. G. J. K.

537.12 : 539.15

3965. Classical radius of the electron and displacement of the 2*S*-level of the hydrogen atom. CALDIROLA, P. Letter in *Nuovo Cim.*, **5,** 207–8 (*June*, 1948) *In Italian.*—See Abstr. 1008 (1949).

537.12

3966. Some cut-off methods for the electron self-energy. RZEWUSKI, J. *Proc. Phys. Soc., Lond.* **62,** 386–91 (*June*, 1949).—Some Lorentz-invariant cut-off procedures for the electron self-energy are investigated. Expressions for the self-energy are obtained as expansions in inverse powers of the cut-off constant K. The first term, logarithmic in K, has the correct transformation properties for all the cut-offs. The second term, independent of K, is covariant only for one of the procedures. The remaining terms have not the correct properties in any of the procedures, but contain negative powers of K and, therefore, vanish for $K \to \infty$. The one cut-off procedure which gives a covariant constant term can therefore be used for an unambiguous subtraction of the electron self-energy provided that in the final results one proceeds to the limit $K \to \infty$. A

537.122 : 530.14

3967. On an approximation method for the calculation of the self-energy of the electron. DRĂGĂNU, M. *Bull. Soc. Roumaine de Phys.*, **44** (*No.* 81) 19–2 (1943) *In German.*—The self-energy is considered t arise by interaction between the corpuscular imag of the electron and a probability distribution c location in space-time. According to an earlie suggestion of the author [*C.R. Acad. Sci., Roum* **24,** 94 (1941)] the concept of a finite uncertaint domain is introduced. Operators in this domain ar introduced by averaging ordinary quantal operator over a gaussian probability distribution of locatio in the domain. This leads to operators differin from ordinary quantal operators by a factor whic induces convergence and thus leads to an approx value $137mc^2/2\pi\gamma^2$ of the self-energy. The factor and with it the size of the domain $\gamma e^2/mc^2$ is le undetermined. The relativistic invariance of th theory is not discussed. H. MC

537.122 : 530.14

On the problem of the self-energy of the electron in the theory of Gustafson. *See Abstr.* 3762

537.122 : 538.22

3968. Collective electron ferromagnetism. I. WATANABE, H. *J. Phys. Soc. Japan*, **3,** 12–18 (*Jan.–Feb.*, 1948) *In English.*—The magnetic properties of an electron model in which the density of level in the energy band is constant with respect to the energy of electrons, are discussed with respect t the band form and the value of the exchange integral The case where the density of levels is constant i worked out in detail. A. E. DE H

537.122 : 538.22

3969. The temperature dependence of paramagnetic susceptibility of a relativistic electron gas. SINGWI, K. S. *Proc. Nat. Inst. Sci. India*, **14,** 339–48 (*Sept.–Oct.*, 1948).—The expressions are derived both for degeneracy and for non-degeneracy. The non-relativistic expressions, for both cases, are also given for the sake of completeness. A

537.122 : 538.224

3970. Diamagnetism of a relativistic electron gas. SINGWI, K. S. *Proc. Nat. Inst. Sci. India*, **14**, 349–57 (*Sept.–Oct.*, 1948).—The diamagnetic susceptibility of a relativistic degenerate electron gas is deduced from energy considerations. The results of the present straightforward method agree with those deduced in a recent paper [*Proc. Nat. Inst. Sci. India*, **14**, 125 (1948)] by the author from the perturbation theory in quantum mechanics. A.

537.132

3971. The specific charge of the positron. BARNÓTHY, J. Letter in *Phys. Rev.*, **74**, 844 (*Oct.* 1, 1948).—The charge of the positron might be expected to be > that of the electron by the same fraction as its mass. The *g*-values may also be different. Present evidence is not accurate enough to be conclusive. G. J. K.

ELECTROSTATICS . DIELECTRICS 537.2

537.21 : 621.317.72

3972. A new static voltmeter. GREINACHER, H. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 273–7 (1948) *In German.*—The principle of the rise of a liquid dielectric in a condenser [see Abstr. 3981 (1949)] has been used to give a robust, rapid, suspensionless voltmeter. The rise of a light oil in the condenser is observed in a microscope eye-piece with a scale of 100 divs. (read to 0·1 div.), the voltage being given by $281\sqrt{h}$ (h = reading) for a.c. or d.c. voltages. Capacitance 2 $\mu\mu$F and resistance 5×10^{13} Ω. Use of a higher dielectric constant for the filling gives a greater sensitivity, full scale being 460 V with nitrobenzene. With suitably curved electrodes a linear scale could be obtained. D. H. W.

537.221

3973. Contact-potential measurements on irradiated metal-oxide surfaces. NEUERT, H. *Z. Naturforsch.*, **3a**, 226–8 (*April*, 1948) *In German.*—The contact potential measurements are made by the Kelvin method using an amplifier arrangement and an oscillograph. Metal surfaces and metal oxide surfaces are first activated by means of u.v. light rays, ions, electrons, and in several cases by polishing and other forms of mechanical treatment. Thereafter records are taken of contact potential for each surface with Ag as standard. Variation of contact potential with time after activation is illustrated by curves giving the value of the contact potential against deflection as shown on the c.p.o. Effects observed are attributed to u.v. radiation of short wavelength. Numerical values of contact potential differences are given for a large number of materials, measured about 30 sec after the observed contact potential changes, when the surfaces would have recovered initial contact potential differences. G. G.

537.221

3974. Frictional electricity. GILL, E. W. B. Letter in *Phys. Rev.*, **74**, 842–3 (*Oct.* 1, 1948).—Observations relating to charges produced on small insulating particles sliding down a metal funnel were given by Debeau [Abstr. 2598 (1944)] together with certain suggested explanations. It is now shown that the observed results admit of an alternative explanation in which the particles reach a sufficiently high potential to produce a discharge through the air round them. On this view the charge/air-pressure curve would resemble the well-known curve of sparking potential against pressure. The observation that the charge has a min. value at about 1 mm Hg pressure is thus accounted for. G. G.

537.221

3975. Frictional electrification of sand. GILL, E. W. B. *Nature, Lond.*, **162**, 568–9 (*Oct.* 9, 1948).—By means of a simple experiment it is shown that the free fall of dry sand produces a potential of measurable magnitude. It is concluded that the sand rubbing on itself produces positive charges on the smallest particles and negative charges on the larger ones. This observation is believed to explain the build-up of high potentials in dust storms. R. H. G.

537.226

3976. On the theory of dielectric polarization of L. Onsager. ZAKRZEWSKI, K. AND PIEKARA, A. *Bull. Int. Acad. Polonaise Sci. Lett. A* (4–10) 168–75 (*April–Dec.*, 1939) *In German.*—Assuming the reaction field parallel to the permanent dipole moment rather than the total moment, the Onsager expression is modified to

$$P=\frac{\varepsilon-1}{4\pi}E=N\left[\frac{\mu'\mu^{**}}{3kT}+\frac{\varepsilon(n^2+2)}{2\varepsilon+n^2}\alpha\right]E$$

where $$\mu^{**}=\frac{(2\varepsilon+1)\varepsilon}{3}\left(\frac{n^2+2}{2\varepsilon+n^2}\right)^2\mu$$

and $$\mu'=\frac{(n^2+2)(2\varepsilon+1)}{3(2\varepsilon+n^2)}\mu$$

This theory leads to dipole moments up to 15% < the Onsager values as calculated from pure liquids or solutions. D. H. W.

537.226

3977. Dielectric behaviour of methyl palmitate; evidence of resonance absorption. DRYDEN, J. S. AND JACKSON, W. *Nature, Lond.*, **162**, 656 (*Oct.* 23, 1948).—Measurements of the dielectric properties of methyl palmitate suggest that there are 3 absorption regions in the frequency range investigated (50 to 3×10^{10} c/s): one at very low frequency, presumably due to rotation of the molecule about an axis perpendicular to its axis, a second absorption (between 10^7 and 10^8 c/s) due to rotation of the molecule about its axis, the moving unit being the double molecule, and a third, ultra-high frequency, absorption which may be a resonance phenomenon. E. R.

537.226

3978. The causes of molecular polarisation in dielectrics. BRABLC, J. *Conf. Int. Gr. Rés. Élect.* [*CIGRÉ*] (*Rep. No.* 119*a*) 7 *pp.* (1948) *In English.*—A thermodynamic conception of molecular polarization is suggested. Molecules comprised of atoms with the same atomic heat have no molecular polarization, and molecules with atoms of different atomic heats possess it. Permanent dipoles are formed by the thermal movements of the molecules, which are

determined by the oscillations of the most highly energized atoms. E. R.

537.226 : 621.3.011.5

3979. Dielectric properties of titanates at ultra-high frequencies. POWLES, J. G. *Nature, Lond.*, **162**, 614 (*Oct.* 16, 1948).—The permittivity and p.f. of $MgTiO_3$, $CaTiO_3$ and $SrTiO_3$ do not differ appreciably at 1 Mc/s and 9 450 Mc/s, but $BaTiO_3$ shows a substantial decrease in permittivity at 9 450 Mc/s and a still further decrease at 24 000 Mc/s, as well as a marked increase in p.f. at the 2 ultra-high frequencies. Over the range 20° to 170°C, the permittivity of $BaTiO_3$ at 9 450 Mc/s is lower than at 1·5 Mc/s, but the rapid rise to a peak value occurs at about the same temp. in the 2 cases. E. R.

537.226 : 621.3.011.5

3980. Dielectric properties of mixed barium and strontium titanates at 10 000 Mc/s. POWLES, J. G. *Nature, Lond.*, **162**, 655 (*Oct.* 23); *errata*, 690 (*Oct.* 30, 1948).—The dielectric properties of mixed Ba and Sr titanates have been determined at 9 450 Mc/s for different proportions of the 2 materials. The Curie point is at 20°C for the 72% $BaTiO_3$, 28% $SrTiO_3$ mixture. The marked variation in permittivity at 1·5 Mc/s for this mixture is considerably modified at 9 450 Mc/s. The dispersion in permittivity suddenly becomes appreciable, and the power factor rises rapidly for concentrations of $BaTiO_3$ well below that at which the material becomes permanently polarized. E. R.

537.226.2

3981. A method for determining the dielectric constants of liquids. GREINACHER, H. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 261–72 (1948) *In German.*—An absolute method of measuring the dielectric constant, ε, is described depending on the rise of liquid in a condenser when a voltage is applied. From the formula $hpg = (\varepsilon - 1)V^2/8\pi a^2$, ε can be derived knowing the density, ρ, the applied voltage in e.s.u., V (200–2 000 V a.c. or d.c.), the distance between the electrodes, a (~ 1 mm) and the additional capillary rise, h ($\leqslant 1{\cdot}2$ mm), which is observed on the eyepiece scale of a microscope. The formula is verified for variations in V, a and h, and values of ε correct to 5% are obtained for a series of liquids, including benzene and water. Using smaller, cylindrical electrodes relative values of ε are obtained, using only 2 cm³ of liquid, which may be slightly conducting. D. H. W.

537.226.2

3982. Measurement of the dielectric constant of gaseous ammonia, carbon [mon]oxide and hydrogen as a function of pressure and temperature. VAN ITTERBEEK, A. AND DE CLIPPELEIR, K. *Physica, 's Grav.*, **14**, 349–56 (*June*, 1948) *In English.*—The dielectric constants were measured at temps. between 0° and 130°C and at pressures from 1 to 16 atm., and the dipole moment, polarization and polarizability were deduced. E. R.

537.226.2 : 621.315.59

3983. Determination of the electromagnetic constants of semi-conductors in the ultra short wave range. JACOTTET, P. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 251–60 (1948) *In German.*—A supplement to Fejér and Scherrer's theoretical and experimental work on the determination of the dielectric const. in cavi resonators in the cm-wave range furnishing data o permeability and on the dielectric and magnetic lo angles. The tested substance is placed on a met piston closing the cavity resonator and the peak the resonant field strength is measured, i.e. thickne of the material. The periodically damped cur obtained permits of determination of the natur wavelength in the semiconductor, thus of its ε and from the period, and, furthermore, its dielectric an magnetic loss angles, δ_ε and δ_μ, from the dampi decrement. Theoretical principles of measureme and experimental data are given.

537.226

3984. The dispersion of the dielectric constant Rochelle salt crystal at low frequencies. KAWAI, H AND MARUTAKE, M. *J. Phys. Soc. Japan*, **3**, 8–1 (*Jan.–Feb.*, 1948) *In English.*—Measurements of th dielectric constant from ½–1 000 c/s for Rochelle sa are made by observing the angle of rotation of needle of the salt suspended in the a.c. field. Abov the Curie point, 26°C, there is only a fictitious dis persion due to surface leakage, but below it there i one dispersion region centred about 10 c/s with $\Delta\varepsilon \sim$ 300, and a second larger dispersion below 1 c/s whic is not completely covered. The position and intensit are affected by humidity. D. H. W

537.228.

3985. Equations of piezoelectricity. CADY, W. G Letter in *Nature, Lond.*, **162**, 933–4 (*Dec.* 11, 1948).— A detailed reply to a criticism by Cook [*ibid.*, **161** 524 (*April* 3, 1948)] that a certain energy equatio containing mixed units given in Cady's book *Piezoelectricity*, is in error. The author demon strates the validity of the equation but points out tha in interpreting the derivatives, care must be taken t distinguish between internal and externally impresse stresses. H. J. H. S

537.228.1 : 534.21

3986. Wave propagation in piezoelectric crystals KYAME, J. J. *J. Acoust. Soc. Amer.*, **21**, 159–6 (*May*, 1949).—The propagation of plane waves in piezoelectric (p.e.) medium has been studied. A simultaneous solution of Maxwell's field equation and Newton's law of force gives the necessary con ditions for wave propagation in the infinite medium By p.e. coupling, every electromagnetic wave ha associated with it an elastic wave. Non-p.e. crystal are, at best, birefringent electromagnetically an trirefringent acoustically. In p.e. media, the electro magnetic and elastic modes are coupled, thus givin 5 phase velocities for both the electromagnetic an acoustic waves. These media are therefore electro magnetically and acoustically pentrefringent. Th slower electromagnetic waves are the field variation accompanying the elastic waves, while the fast elasti waves are the mechanical deformations accompanyin the electromagnetic wave. The displacement in th elastic wave will differ in phase by 90° from the electro magnetic wave, its amplitude being $\propto$ the electri field strength and inversely $\propto$ the frequency o vibration. The flux of energy will, in general, be i directions different from that of phase propagation The generalized Poynting vector will be the sum o two vectors representing separately the flux of electro

magnetic energy and the flux of elastic energy. Analysis was made of propagation in a particular direction in sphalerite. The orientation of the vectors involved has been calculated for the fast and slow modes of vibration. A study of specific boundary value problems gives interesting results. The p.e. effect gives a contribution to the reflection of electromagnetic waves at an interface. This results in a small correction to be applied to the familiar expressions for the reflection coefficients. This correction might be used to determine p.e. constants, providing it is possible to measure accurately the reflection coefficients and other constants involved. Slabs of p.e. media may be set into mechanical vibration by an incident electromagnetic wave. At particular frequencies the crystal may be set into resonance. At resonance for the elastic wave there is almost perfect reflection of the incident electromagnetic wave. It should be possible to detect these resonances by absorption measurements. The p.e. slab, if set into resonance by an acoustic wave, emits a weak electromagnetic signal. A.

537.228.1 : 534.232

Application of activated ceramics to transducers. *See Abstr.* 3840

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311.1

3987. Theory of the interaction of electrons in the crystal lattice (multielectron models of metals and semiconductors). Vonsovsky, S. V. *Izv. Akad. Nauk, SSSR*, **12** (*No.* 4) 337–52 (*July–Aug.*, 1948) *In Russian.*—A critical survey is made of various one-electron models, and attempts at calculating the electron interaction by the theory of small perturbations. The general theory of electron interaction in the crystal is then considered. Two problems are considered: (1) expressing in a general theory the fact that electrons are distributed "freely" through an ideal crystal lattice; (2) calculation of the accelerating effect of the electric field on the electrons. The method adopted is the density matrix method introduced by Landau [*J. Exp. Theor. Phys.*, **7**, 379 (1937)] and Neumann and Dirac. Equations are derived which show that, at least in the simplest cases, the general theory in which the interaction of the electrons is taken into consideration gives results similar to that of the one-electron theory. The most important conclusion to be drawn is that electrons occupying uniformly filled zones do not participate in current formation in crystals. There follows a discussion of Frenkel's "exchange" model which, though applied successfully to such problems as magnetic anisotropy and magnetostriction, is limited to a description of the lowest (insulated) states of dielectrics. An intermediate scheme is desirable which combines the simplicity of one-electron models and the electronic interaction of the "exchange" model [*J. Exp. Theor. Phys.*, **16**, 981 (1946)]. Such a model is the (*s–d*) "exchange" model in which is solved the problem of the movement of one external *s* electron in a field of lattice ions and *N* internal *d* electrons. This model is not completely satisfactory and a polar model is finally discussed in which possibilities of electron charge transfer and electron excitation are taken into account. Limitations of this method are also considered together with results obtained using this method. The final conclusion drawn is that it is more accurate to speak of an electron "liquid"—with all the complications implied—rather than an electron "gas" in a crystal. W. H.

537.311.33

3988. The structure and electrical properties of surfaces of semiconductors. I. Silicon carbide. Jones, T. K., Scott, R. A. and Sillars, R. W. *Proc. Phys. Soc., Lond. A*, **62**, 333–43 (*June*, 1949).—Electrical contacts with faces of SiC and of many other semiconductors do not obey Ohm's law. This property of SiC has been attributed to an amorphous film known to occur on faces of the crystal. Theoretical work relating to such contacts is hampered by lack of knowledge of the essential physical features of the model. In this paper a study is made of the manner in which the surface texture of the crystal affects the electrical properties of the contact. The electrical characteristics of a contact between a rounded metal point and the demonstrably smooth face of a crystal were shown to vary only slowly across the surface. A series of observations was made of the electrical properties and of the electron diffraction patterns of a basal plane of a crystal as the overlying film of amorphous material was removed. The results show that the presence of the amorphous film is not essential to the exhibition of the special electrical properties of the contact. A.

537.311.33 : 539.23 : 541.128

Semi-conductivity measurements in the study of catalysis on copper oxide. *See Abstr.* 4213

537.311.33 : 548.0

The effective mass of the polaron. *See Abstr.* 4253

537.311.33 : 550.362

3989. The electrical conductivity of rocks at high temperatures. Coster, H. P. *Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **5**, 193–9 (*Jan.*, 1948).—Measurements of the electrical conductivity, σ, of rocks at high temps. are described. It is shown that σ increases with the temp., T, approx. as $\exp(-\varepsilon/kT)$. The theoretical implications of this and the bearing on the conductivity within the earth are discussed. A.

537.311.35

3990. Contribution to the study of liquid semiconductors. Eck, J.-L. *Ann. Phys., Paris*, **4**, 12–61 (*Jan.–Feb.*, 1949) *In French.*—The variation of current strength I with time t, after the application of an e.m.f. is found to fit the equation $I - I_\alpha = (I_0 - I_\alpha)\varepsilon^{-Kt}$ where I_0 is the initial current, I_α is the limiting current, and K is a constant which contains the ionic mobilities. The effect is assumed to be due to the initial existence of large ionic clusters in the body of the liquid which gradually disperse. In certain cases the current rises rapidly on the first application of the voltage and then falls off exponentially. Experiments are described on acetone, nitrobenzene, and acetone-substituted compounds, and the effects of electrode material, of interrupting

or varying the applied e.m.f. and of space charges near the electrodes, are analysed. The use of Pt electrodes leads to a higher conductivity than Ni electrodes, and it is found impossible to assign a definite "resistance" to such liquids. C. A. H.

537.311.4

3991. Dependence of the contact resistance of a semi-conductor on the frequency of the field. SHMUSHKEVICH, I. M. *J. Exp. Theor. Phys., USSR*, **18**, 462–74 (*May*, 1948) *In Russian.*—The variations of the distribution of the electron concentration and field in a chemically homogeneous semi-conductor making contact with a metal are studied for passage of a.c. of small amplitude. The problem is solved for 2 limiting cases of the frequency, low and high compared with the value of the reciprocal time of establishment of diffusion equilibrium. It is hereby assumed that no exhaustion by admixtures occurs near the electrodes. It is shown that for high frequencies the contact resistance falls as $\omega^{-\frac{1}{2}}$ and the phase difference between current and voltage is 45°. A.

537.312.5

3992. The change of photo-conductivity of cadmium sulfide between room temperature and the temperature of liquid air. BRENTANO, J. C. M. AND DAVIS, D. H. Letter in *Phys. Rev.*, **74**, 711–12 (*Sept.* 15, 1948).—Observations on CdS crystals have led to the assumption that the photo-conductive behaviour of this crystal closely resembles the photographic Herschel effect, and a common mechanism is suggested as the basis of these obviously related phenomena. W. S.

537.312.5 : 621.383

3993. New photoconductive cells. SCHWARZ, E. Letter in *Nature, Lond.*, **162**, 614–15 (*Oct.* 16, 1948).—A new method of producing infrared sensitive photocells is based on the practical application of the view that O is adsorbed on the semi-conductors, but not taken up by the lattice. An electric discharge is used in increasing the adsorption. The practical results are: stability in air, good reproducibility and uniformity of the mass-produced cells which can be manufactured to any shape or size. The sensitivity in the infrared region of 1–2 μ of such cells is superior to high sensitive vacuum thermocouples. W. S.

537.312.62

3994. The Barlow wheel of superconducting material. HEISENBERG, W. AND VON LAUE, M. *Z. Phys.*, **124** (*Nos* 7–12) 514–18 (1948) *In German.*—On the basis of the electrodynamics of superconductors [Abstr. 1797 (1935)] the moment of force is calculated which is exerted by an axial magnetic field upon a superconducting ellipsoid of rotation into which a current is led in at the poles and withdrawn through contacts at the equator. If these contacts, including the boundary layer, are superconducting, no force is exerted. If, however, the contact is such that the current passing the boundary layer is normal, a moment does occur. This is equal to that in an ordinary conductor if all dimensions of the ellipsoid are $\ll$ the penetration depth d of the magnetic field. If they are $\gg d$ the moment is reduced by the factor $(2d/R)(H'/H)$ where R is the radius of the equator and H'/H the ratio of the field strength at the equator to that at infinity. H. L.

537.312.62

3995. The superconductive transition. MACDONALD, D. K. C. AND MENDELSSOHN, K. Letter in *Nature, Lond.*, **162**, 924 (*Dec.* 11, 1948).—The restoration of resistance of superconducting pure Sn, Hg and Pt by longitudinal magnetic fields even for good specimens was found to be spread over a short range of fields $\propto$ the critical field at that temp. No hysteresis effects were observed except with specimens which ended in bulbs. D. S.

537.312.62 : 538.66

3996. Temperature dependence of penetration depth of a magnetic field in superconductors. DAUNT, J. G., MILLER, A. R., PIPPARD, A. B. AND SHOENBERG, D. Letter in *Phys. Rev.*, **74**, 842 (*Oct.* 1, 1948) *In English.*—It is pointed out that the Hg colloid experiments of Shoenberg [Abstr. 1630 (1940)] indicate a law $[\lambda(0)/\lambda(T)]^2 = 1 - (T/T_c)^4$ for the variation with temp. T of the penetration depth λ of a magnetic field into a superconductor of transition temp. T_c. More recent experiments provide no strong evidence either for or against this law. D. S.

537.32 : 535.32

3997. Electrical conductivity and refractive index of barium titanate. BUSCH, C., FLURY, H. AND MERZ, W. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 212–15 (1948) *In German.*—The conductivity has been measured on a number of single crystals. The conductivity-$10^3/T$ curve at higher temps. complies with the equation $\sigma = A(T) \times \varepsilon^{-E/2kT}$, the energy of activation E being 1·75 eV. Near the Curie temp. $T_e = 120$°C the slope of the curve decreases, E becoming 1·15 eV. Below the Curie point the slope increases again. This behaviour is in accordance, at least qualitatively, with the Mott hypothesis. F. L.

537.322.2

3998. Thomson coefficient of some metals at high temperatures. EKKERS, G. J., FARNER, A. AND KLÄUI, R. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 218–19 (1948) *In German.*—Measurements of the Thomson coeff. were made with W (up to 2 700°K), Mo (900–2 200°K), and Pt (1 200–1 700°K). By means of a disappearing filament pyrometer temps. were measured along wires consisting virtually of 2 wires of different diameter. Theoretical values (Sommerfeld) for the Thomson coeff., assuming one free electron per one atom, are given by $-1{\cdot}2 \times 10^{-8} VT$/deg K ($V$ = voltage), the observed values being: W, 0·93; Mo, 1·05; Pt, 1·05, instead of 1·2. F. L.

537.3

3999. Properties of aqueous solutions of perchloric acid. BRICKWEDDE, L. H. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 309–29 (*March*, 1949).—Several properties of the system $HClO_4$–H_2O for concentrations of $HClO_4$ varying from 0 to 70% by weight have been measured from −60° to +75°C. These properties include density, viscosity, electrical resistivity, and freezing temperatures of the solutions. A.

ELECTRIC DISCHARGES 537.52

537.523.4

4000. The theoretical criterion for streamer advance in an electrical field. LOEB, L. B. AND WIJSMAN, R. A.

Letter in *J. Appl. Phys.*, **19**, 797–9 (*Aug.*, 1948).—An extension of previous work on sparking equations for the higher pressure regions [Abstr. 2130 (1948)] which were based on the assumption that the streamer advance proceeds by avalanches built up from single photoelectrons ahead of the advancing streamer. The present work deals with advance due to several simultaneous avalanches, and the final sparking equation involves, besides Townsend's α, etc., photo-ionization cross-sections, and the number of photons produced for each positive ion in the streamer tip. A trial-and-error method of solving the equation is described. J. D. C.

537.523.4

4001. On the mechanical efficacy of sparks in liquids. FRÜNGEL, F. *Optik*, **3** (*Nos* 1–2) 124–7 (1948) *In German.*—A condenser is discharged through a concentric cylindrical test electrode under water and the mechanical effect of the spark discharge is measured by means of the height to which a small weight is thrown as the result of the pressure exerted by the discharge in the liquid medium. As compared with the energy stored in the condenser the mechanical energy dissipated is found to be $\sim 1\%$. The energy is found to be transferred within about 1 μsec. The nature of the losses is tentatively examined and the possibility of producing periodic mechanical pulses is mentioned. R. H. G.

537.523.4

4002. The light intensities of strong spark discharges. FRÜNGEL, F. *Optik*, **3** (*Nos* 1–2) 128–36 (1948) *In German.*—An electric circuit is described to produce in a 2 mm spark the max. possible light intensity lasting about 10^{-7} sec. Two methods are described for measuring the intensity oscillographically by means of a photocell, and a special electronic circuit is developed to study the time relationship of the light emission. Several typical oscillograms are reproduced. The light intensities produced correspond to a black-body temp. of 10^{5}°. In rare gases the intensity is $>$ in N_2 and, in the range investigated, i.e. up to about 10 atmos., it increases almost linearly with pressure. The spectrum emitted is found to be continuous. R. H. G.

537.523.5

4003. Some features of the burning of an a.c. arc. PROKOFIEV, V. K., STARTSEV, G. P. AND TAGANOV, K. I. *Izv. Akad. Nauk, SSSR*, **12** (*No.* 4) 392–4 (*July–Aug.*, 1948) *In Russian.*—The arc investigated was of an intermittent type in which arcing was initiated every $\frac{1}{2}$-cycle by an auxiliary spark. Synchronization was achieved by means of a variable resistance in series with the transformer feeding the auxiliary spark. High-speed photographs were taken at 3 000 frames/sec. These photographs show that a h.f. discharge immediately precedes striking and that a glowing gas-cloud persists for about $\frac{1}{2}$ millisec after arcing ceases. With oxidized electrodes, particles thrown off from the electrodes produce inhomogeneities in the arc. For this reason oxidation should be prevented in quantitative spectro-analysis, especially of Al and Zn alloys. When the electrode is solid the position of the arc is steady, but if a globule of molten metal forms, the point of contact of the arc moves about on its surface. In quantitative analysis care must therefore be taken to avoid melting the electrode tip. A. SCH.

537.523.5

4004. The high current carbon arc and its mechanism. FINKELNBURG, W. *J. Appl. Phys.*, **20**, 468–74 (*May*, 1949).—The properties of the contracted arc stream are discussed and a general theory of arc streams is presented. Starting from the anodic mechanism for the low current arc, the anodic mechanism of the high current arc is developed. The rising voltage characteristic, the anodic vapour stream, and the high crater brightness are explained as a consequence of an abnormal voltage drop in front of the anode which increases with increased current density and is caused by a very rapid evaporation of the anodic material. The important role which the magnetic field of the arc current plays in the stabilization of all high current arcs is pointed out. The author believes that this unique high temp. arc has a bearing on other arc and spark discharges, and also will play an important role in future developments of high temperature physics and chemistry. A.

537.525.72

4005. Starting potentials of electrodeless discharges. GILL, E. W. B. AND VON ENGEL, A. *Proc. Roy. Soc. A*, **197**, 107–24 (*April* 22, 1949).—Records measurements of the starting field which have been carried out at pressures between about 0·2 and 350 mm Hg in H, N, Ne and some in D and He covering a range of wavelengths between 5 and 2 000 m in vessels of different sizes and types of glass. [See also Abstr. 976 (1948)]. A.

537.53

4006. Theory of losses. UGAROV, V. A. *J. Exp. Theor. Phys., USSR*, **18**, 457–61 (*May*, 1948) *In Russian.*—An assembly of interreacting particles is considered using a varied Maxwell–Boltzmann equation. A flow of interreacting particles uniform throughout space (where repellent forces prevail) becomes unstable and eventually periodic with respect to density when the drift velocity is $\not>$ a critical value. This result is applied to the experimentally established fact of the periodic structure of beams in discharge tubes. This result is generalized to include particle mixtures such as electrons and neutral particles. A.

X-RAYS 537.531

537.531 : 535.3 : 548.73

4007. Effect of hydrogen atoms on intensities of X-ray reflexions. MORRISON, J. D., BINNIE, W. P. AND ROBERTSON, J. M. Letter in *Nature, Lond.*, **162**, 889–90 (*Dec.* 4, 1948).—In aliphatic compounds H atoms produce $\sim 20\%$ of the scattering, and satisfactory agreement between calculated and observed intensities is not obtained without taking them into account. The empirical f-curve for H has a rapid fall-off with angle. A. J. C. W.

537.531 : 535.3

4008. A new method of investigating X-ray absorption spectra in gases. BROGREN, G. *Ark. Mat. Astr.*

Fys., **36 B**, *Paper* 2, 4 *pp.* (1948) *In English.*—Preliminary details are given of a method for examining the absorption edges and secondary structures of rare gases. Essentially, the gas being studied is itself used to fill the Geiger–Muller counter tube. Doing so eliminates the 2 windows of the absorption chamber. Comparison of the new method with that normally used shows that the elimination of the 2 cellophane membranes increases considerably the number of impulses. Also, with the new method the max. number of impulses is obtained for max. absorption, the reverse of what happens with the old method. A. H.

537.531 : 535.3 : 541.18

4009. The dependence of the X-ray small angle scattering on shape and size of colloidal particles in dilute systems. IV. POROD, G. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 255–92 (1949) *In German.*—The diffraction of X-rays in disperse systems has been used for the determination of size and shape of colloidal particles [Abstr. 1932 (1949)]. Methods for the computation of scattering-intensity curves for differently shaped particles, such as rotation ellipsoids, cylinders and prisms are developed. If experimental scattering-intensity curves are given, the shape and size of the particles concerned can be evaluated by comparison with theoretically derived curves. R. H. H.

537.531 : 535.33

4010. New observations on the emission of X-rays from atoms multiply ionised in deep layers. CAUCHOIS, Y. *C.R. Acad. Sci., Paris*, **222**, 1484–6 (*June* 24, 1946) *In French.*—Previous work [*J. de Phys.*, **5**, 1 (1944)] is continued. Various satellites associated with the X-ray spectra of U, Bi, Pt and Au are discussed. L. S. G.

537.531 : 535.343

4011. Discontinuity of *K* absorption of copper X-rays in aluminium–copper alloys at different stages of precipitation. WEILL, A. R. *C.R. Acad. Sci., Paris*, **227**, 202–4 (*July* 19, 1948) *In French.*—The X-ray absorption fringe of copper in the region of the *K* absorption edge was investigated in Cu–Al alloys containing 4% Cu by weight, at 4 stages of precipitation, and compared with that for pure Cu. H. P. M.

537.531 : 535.4 : 548.734.84

4012. X-ray absorption in diffracting crystals. v. LAUE, M. *Acta Cryst.*, **2**, 106–13 (*April*, 1949) *In German.*—In the dynamical theory of X-ray diffraction the absorption of the incident ray is not independent of that of the diffracted ray, and the absorption coefficients may not be equal. Diffraction may lead to decreased absorption. The mathematical theory is worked out in detail, and illustrated with numerical calculations for Cu $K\alpha$ radiation diffracted by thin ($\sim 10^{-2}$ cm) plates of NaCl cut || to (111) and (010). The results are in qualitative agreement with the experiments of Borrmann [*Phys. Z.*, **42**, 157 (1941)]; quantitative agreement is not to be expected as the approximate magnitude of certain Fourier coefficients not theoretically or experimentally determined is assumed. A. J. C. W.

537.531.08

4013. General theory of methods of measuring X-rays. TELLEZ-PLASENCIA, H. *J. Phys. Radium* (*Sér.* 8) **9**, 230–5 (*July–Aug.–Sept.*, 1948) *In French.*—Relations are derived between the energy of the incident X-ray beam and the energy and number of recoil- and photo-electrons. These are applied to predict the response (blackening of photographic plate, counting rate of G.M. counters, ionization current) of the detector as a function of the energy and wavelength of the beam. A. J. C. W.

537.531.85

4014. Higher approximations in the calculation of the Compton effect by radiation theory. CORINALDESI, E. AND JOST, R. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 183–6 (1948) *In German.*—The second approximation for the Compton effect is obtained using the subtraction procedure of Lewis and Epstein [Abstr. 1769, 2716 (1948)]. After a canonical transformation the cross-section contains divergent terms for large momentum which can be eliminated either by their connection with self-energy or renormalization of the charge. A divergence for small momenta is removed by subtracting terms arising from the double-Compton effect. No details are given. G. J. K.

CATHODE RAYS . POSITIVE RAYS
537.533/.534

537.533.3 : 521.1 : 621.385.16

4015. Application of celestial mechanics to the theory of a magnetron. I–III. HAGIHARA, Y. *J. Phys. Soc. Japan*, **3**, 70–86 (*Jan.–Feb.*, 1948) *In English.*—The mono-phase oscillations of a magnetron with 4 split anodes is considered in I, assuming an inverse square law for the electrostatic potential. Electron motion is defined in terms of a system of linear differential equations with periodic coefficients, the solutions of which are discussed by a matrix method [see Abstr. 2580 (1928)]. The formation of rotating electron poles is deduced and resonance domains are discussed. In II, the results of I are used to determine the electron density, and a corrected electrostatic potential is then calculated from Poisson's equation. No new resonance domains appear as a result of this correction. The discussion is extended in III to magnetrons with > 4 split anodes. R. A. N.

537.533.3 : 621.385.83

4016. A magnetic resonance accelerator for electrons. HENDERSON, W. J., LECAINE, H. AND MONTALBETTI, R. Letter in *Nature, Lond.*, **162**, 699–700 (*Oct.* 30, 1948).—An experimental test on the second type of accelerator described by Veksler [*J. Phys., USSR*, **9** (*No.* 3) 153 (1945)] in which the electrons perform circular orbits in a magnetic field and pass, once per orbit, through a cavity resonator with a large r.f. voltage across the gap. Each passage through the gap gives enough energy to the electrons to raise it to another orbit with the same periodic time. The resonance condition is $2\pi V/Hc = T$. (V = r.f. voltage, H = magnetic field, T = period of r.f. wave.) Energies of 4·6 MeV were obtained as expected. An injection system is unnecessary, electrons arising in the gap of the cavity serving the purpose. The resonant field is not sharply defined and the writers propose an explanation. A. H. W. B.

537.533.3 : 621.385.83

4017. Air-cored synchrotron. KAISER, T. R. AND TUCK, J. L. *Nature, Lond.*, **162**, 616–18 (*Oct.* 16, 1948).—A method of injecting electrons into a fixed-frequency synchrotron without the use of the betatron effect is described. Electrons are injected at the inside of the "doughnut" with energy making their frequency of revolution $1/n \times$ the r.f. used, where n is an integer. The equilibrium orbit then expands as they are accelerated until they approach the outside of the vacuum chamber when the oscillator is suppressed. The orbits then shrink till their frequency of revolution is $1/(n-1) \times$ the r.f., when the oscillator is reapplied. A succession of steps may be employed until extreme relativistic conditions are reached. Approximate conditions for an 85 MeV air-cored synchrotron of outer diameter 28 cm are given. J. H. F.

537.533.331 : 621.385.833

4018. Effects of defect of shape of a simple electrode in electron-optics. BERTEIN, F. *J. Phys. Radium* (*Sér.* 8) **9**, 104–12 (*March*, 1948) *In French.*—The optical aberrations caused by lack of perfection in the construction of the parts of an electron-optical instrument are often considerable. In the present paper purely electrostatic instruments are considered, and the geometric faults are studied, such as imperfections of shape and bad centring of parts. A general method of calculation is given, which allows the designer to foresee the effect on the real performance of the instrument, of departures from the ideal in its construction. A. C. M.

537.533.35

4019. Theory of the "moiré" effect. GREEN, T. A. AND WEIGLE, J. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 217 (1948) *In French.*—The very fine periodical structure of two similar screens can be detected by the "moiré" effect produced when superimposing these screens. The authors suggest that this property could be used to see atoms in superimposed crystals by means of an electron microscope. T. B.

537.533.35 : 621.385.833

4020. Demonstration of electron diffraction and electron microscopy. MÖLLENSTEDT, G. AND HEIDENHEIM, Z. *Optik*, **3** (*No.* 3) 221–32 (1948) *In German.*—The construction and operation of a demonstration model to show the fundamental aspects of electron diffraction and of the electron microscope is fully described. The image is produced on an oscillograph tube about 35 cm in dia. and is of sufficient intensity (75 kV) to be seen by 500 persons. Typical demonstrations are Debye–Scherrer diagrams of polycrystalline Al, the crystalline structure of Sb and single crystal diffraction patterns of mica. Electron optical image formation is shown by suitable disposition of the magnetic lenses. The model described has already run for 400 hours in the Technical High School at Danzig. H. J. H. S.

537.533.35 : 669.1

4021. Some experiences in the application of the electron microscope to the study of steels. CUCKOW, F. W. AND TROTTER, J. *Proc. Phys. Soc., Lond. B*, **62**, 360–5 (*June*, 1949).—Steel specimens have been examined with light and electron microscopes. The replica technique has been used for the electron microscope work, and all the specimens have been studied with both "Formvar" plastic and polystyrene-silica replicas. The micrographs are critically examined and compared. There is an obvious gain in picture sharpness in the electron micrographs, particularly in those from silica replicas. It is found, however, that interpretation of the micrographs from plastic replicas in terms of the geometry of the specimen surfaces is more straightforward. A.

537.533.72

4022. A theory of the solenoid beta-ray spectrometer. PERSICO, E. *Rev. Sci. Instrum.*, **20**, 191–6 (*March*, 1949).—First the case of a point source is considered, and it is found that the resolving power, for a given solid angle, is max. when the emission angle α (average angle between the rays leaving the source and the axis) is 45° 37′. Then the theory is extended to the case of a disc source, and it is found that for a given intensity (product of the source area by the solid angle) there is an optimum source diameter and an optimum emission angle, ranging in practical cases between 36° and 40°. The problem of optimum conditions when the quantity of Cu in the solenoid and the electric power available are limited by economic considerations is also studied, and it is found that the optimum α-value is in this case about 21°. A.

537.533.72 : 621.385.833

4023. Dimensional aspects of the motion of charged particles in electric and magnetic fields. BRÜCHE, E. *Optik*, **3** (*Nos* 5–6) 413–18 (1948) *In German.*—Similarity principles applied to electrons in motion are briefly summarized and their use in developing electron microscopes is described. H. J. H. S.

537.533.73

4024. On the intensity of Kossel lines. MORITZ, E. *Optik*, **3** (*Nos* 1–2) 28–40 (1948) *In German.*—A theory of the origin of Kossel lines is presented which takes into account extinction and multiple Bragg reflection. Good agreement with experiment is obtained. J. T.

537.533.73

4025. Cinematography and fully automatic serial pictures of rapidly varying electron diffraction patterns. MÖLLENSTEDT, G. *Optik*, **3** (*Nos* 1–2) 68–74 (1948) *In German.*—The normal 5 cm pattern is reduced electron-optically to a diameter of 5 mm, with which high resolution document-copying plates are used. This reduction gives an increase in intensity of 10^2 times. A further 10^2 times increase is obtained using an electron beam 1·0 mm instead of 0·1 mm diameter, under Fraunhofer conditions. The combined 10^4 times increased intensity offsets the lack of sensitivity of the plate for electrons. The plates are prepared in 10 cm × 1 cm strips accommodating 20 exposures. 16 mm film can be employed for high rates of taking; the camera must then use high-vacuum oil. To eliminate any trace of gas in the vacuum the camera can be placed outside it, and a U glass screen is then used. Specimen diffraction photographs are given. H. H. HOP.

537.533.73

4026. The removal of incoherent scattering in electron microscopic images and electron diffraction patterns by means of electron filters. BOERSCH, H. *Naturwiss.*,

35 (*No.* 1) 26 (1948) *In German.*—Improved contrast and resolution in electron microscopy and electron diffraction can be obtained by removing the incoherently scattered electrons by filtering. It is necessary to eliminate the effect of electrons which have suffered a loss in energy of only a few eV. The use of an opposing electrostatic field as a filter is advocated. Examples showing the effect of coarse and fine filtering are given. M. R. H.

537.533.73

4027. Validity of the wave-kinematic theory of diffraction. Fues, E. *Optik*, **3** (*Nos* 1–2) 14–16 (1948) *In German.*—The wave-kinematic theory of diffraction is discussed, considering cases where there is a strong interaction between the diffracted and primary rays, and it is shown to lead to correct results. In the paper the diffraction of fast electrons by a crystal plate is primarily considered. A. C. M.

537.533.73 : 548.0

4028. Diffraction of electrons by graphite. Hoerni, J. and Weigle, J. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 215–16 (1948) *In French.*—Diffraction in single crystals $\sim 0{\cdot}05$ mm side and 500–1 500 Å thickness was studied, using electrons accelerated through potentials between 20 and 50 kV. The effect of "beats" between the incident wave and a strong diffracted wave [see Abstr. 1926 (1940)] was detected by using a convergent beam and observing the resulting interference bands. From the measurements the following values for Fourier coefficients of the crystal potential were found: $\Phi_{100} = 1{\cdot}7$ V; $\Phi_{110} = 3{\cdot}2$ V. A. P. F.

537.533.75

4029. The reduction in velocity of medium-fast electrons in transmission through thin metal foils. Lang, W. *Optik*, **3** (*No.* 3) 233–46 (1948) *In German.*—Electrons initially accelerated through 5 to 10 kV were passed through metal foil 180 to 400 Å thick. The emergent beam was bent into a semicircular path by a magnetic field, and allowed to fall on a photographic plate, the resulting photograph giving the velocity distribution in the beam. This distribution showed sharp maxima corresponding, in the case of Al, to energy losses of $14{\cdot}8$ V and multiples of this value, the number of maxima observed and their relative intensities depending on the thickness of the foil. The corresponding values for Ni and Cu were $24{\cdot}2$ and $19{\cdot}1$ V respectively. M. R. H.

537.534

4030. A time-of-flight mass spectrometer. Goudsmit, S. A. Letter in *Phys. Rev.*, **74**, 622–3 (*Sept.* 1, 1948).—A new type of mass spectrometer is proposed, based on the fact that an ion released in a homogeneous magnetic field describes a helical path with angular velocity independent of the velocity and initial direction of the ion; moreover, all ions from a point source pass through a focal line after every 360°. Ions emitted from a pulsed source are collected after several revolutions, and times of flight ($\sim 1\,000$ μsec for $M = 150$, $H = 100$ gauss) measured. Absolute measurements may be difficult, but the method is promising for relative measurements of heavy masses. The relative accuracy increases for increasing mass. T. G. P.

537.534

4031. Doubly charged ion spectra in mass spectra of hydrocarbons. Mohler, F. L., Bloom, E. G., Wells, E. J., Jr., Lengel, J. H. and Wise, C. E. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 369–78 (*April*, 1949).—A compilation of doubly charged ions in the mass spectra of 148 hydrocarbons has been made. In hydrocarbons with 3, 4 or 5 carbon atoms, the most probable double ionization process involves loss of all but 2 or 3 H atoms without breaking C bonds. Unsaturated molecules give larger doubly charged ion peaks than saturated molecules, and ions with an even number of H atoms tend to be more abundant than those with an odd number. In saturated hydrocarbons with 6 or more C atoms, double ionization with breaking of C bonds is most probable, but in benzenes and highly unsaturated molecules, double ionization without loss of C atoms is probable. These heavier molecules show distinctive differences depending on molecular structure. The ratio of ion current at 70 V to that at 50 V ionizing voltage is an indication of the appearance potential of the ion. It increases as the number of H atoms removed increases, and the results indicate that H atoms are removed in pairs to give H_2. A.

537.534 : 535.336.2

4032. A large mass spectrometer employing crossed electric and magnetic fields. Mariner, T. and Bleakney, W. *Rev. Sci. Instrum.*, **20**, 297–303 (*April*, 1949).—A report of progress made, up to cessation of work in 1940, on a large crossed field mass spectrometer designed for a resolution of about 25 000 in order to permit its use for mass measurement. Although development was not completed, nothing in experience with the instrument indicated that the goal could not substantially have been reached. A.

537.534 : 621.384.6

4033. Prebunching: A method controlling synchrotron radial oscillation amplitudes. DePackh, D. C. and Birnbaum, M. Letter in *J. Appl. Phys.*, **19**, 795 (*Aug.*, 1948).—It is proposed that in synchrotrons using betatron injection, the phase and radial oscillations resulting from the transition from betatron to synchrotron operation may be minimized by applying the r.f. field before the failure of the betatron flux condition. If during this period the r.f. amplitude increases as the sth power of time, optimum conditions for small oscillations are given by $4 < s < 12$. In this case, the final oscillation amplitude is $\propto \tau^{-\frac{1}{2}}$, where τ is the time of rise of the r.f. accelerating field. W. I. B. S.

537.534.7

4034. Preliminary experiments for the study of the nuclear reaction by using photographic plates; I. Homogeneity of the range of deuteron beams produced by the cyclotron. Sagane, R., Yamamoto, N. and Imai, Y. *Bull. Inst. Phys. Chem. Res., Tokyo*, **22** 701–6 (1943) *In English.*—Deuteron beams from the small-type cyclotron scattered by a $0{\cdot}17$ μ Au foil at 45° and falling on a photographic plate through triple 2-mm slits showed an energy range of $2{\cdot}5$–$3{\cdot}1$–4 cm, that is, about $0{\cdot}5$ for 2 MeV, when the internal pressure was reduced from 12–14 to 6 mm Hg by the McLeod gauge. Both the maximum jump and

intensity were reduced about 30%. Other manipulations such as increasing the deflector potential or decreasing the width of the slits or reducing the input of the high-frequency waves gave less homogeneous range. The above range is good enough for the study of the energy relation in the nuclear reaction, but not for Oppenheimer–Phillips reaction or the detection of the energy levels in the atomic nucleus. α beams gave a fairly homogeneous range. P. A.

537.534.8

4035. Liberation of electrons from metallic surfaces by impact of ions. D'Ans, A. M., Da Rios, R. and Malaspina, L. *Nuovo Cim.*, **5**, 394–6 (*Aug.*, 1948) *In Italian.*—Measurements were made of the liberation coefficient k (electrons per ion) for impact of H_2^+, He^+ and A^+ ions, accelerated through various potentials $V \leqslant 770$ V, on surfaces of Cu, Ni, Mo and Cu covered with lampblack. As V is reduced, k falls, becoming ~ 0 for A^+ and H_2^+ at ~ 25 V. For He^+, with a Cu electrode, $k \simeq 0{\cdot}15$ below $V = 25$ V; this confirms earlier work [Abstr. 1678 (1934)]. The blackened Cu electrodes had considerably smaller k than the others for a given ion at given V [cf. Abstr. 2604 (1933)]. Blackening is therefore recommended where secondary emission is a disturbing feature. No special outgassing techniques were used for this work, so that adsorbed gases probably played an essential part in the effects. A. P. F.

537.534.8

4036. Secondary electron emission by fast neutral molecules and neutralization of positive ions. Berry, H. W. Letter in *Phys. Rev.*, **74**, 848–9 (*Oct.* 1, 1948).—The numbers of secondary electrons, ejected from Ta by A, He and N_2 ions and molecules of energy 500–4 000 eV, and the cross-sections for neutralization of these ions in their own gases were measured as functions of energy. Positive ion beams were passed through their own gases, where neutralizing collisions (mostly glancing) produced slow ions and fast neutral atoms. The slow ions and the depleted fast ion beam were collected and measured, at various pressures and with positive or negative potentials on the Ta ion beam collector. T. G. P.

DISCHARGE TUBES . COUNTERS 537.54

537.542

4037. A new source of electrons and its adaptation as a source of ions. Keller, R. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 170–2 (1948) *In French.*—An account is given of an adaptation of a Penning cold-cathode manometer suitable for gas pressures 10^{-5} mm to 10^{-3} mm Hg for use as an electron, or positive-ion, source, which can be used under static or pulsed conditions. As an electron source it has been used for electron diffraction and electron microscopy, and as an ion source it has been used for producing neutrons. F. LL. J.

537.542

4038. A self-sufficient apparatus for Geiger–Müller counters. Simons, L. and Grotenfelt, B. *Comment. Phys. Math., Helsingf.*, **13** (*No.* 17) 7 *pp.* (1948) *In English.*—A high voltage source, Neher–Harper stage, sealing circuit (scale of 16), and thyratron stage for a mechanical recorder are described. R. W. P.

537.542

4039. Coincidence measurements of light- and γ-quanta with multipliers. Meyer, K., Huber, P. and Baldinger, E. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 188–92 (1948) *In German.*—A coincidence mixer using germanium crystal rectifiers has been devised for use with multipliers, is capable of handling pulses as small as 0·1 V, and has a resolving time of 10^{-8} sec. R. W. P.

537.542

4040. After effects with U.V.-sensitive counter tubes. Neuert, H. *Z. Naturforsch.*, **3a**, 221–5 (*April*, 1948) *In German.*—Investigations with u.v.-sensitive counters are described. After effects are attributed to increases in the photosensitivity of the whole cathode surface as a result of the discharge. R. W. P.

537.542

4041. A new method of measurement of the curvatures and scattering deflections of cloud chamber tracks. Rüling, J. and Gheri, H. *Experientia*, **4** (*No.* 9) 348–9 (*Sept.*, 1948) *In German.*—The advantage of a differential plot of lateral displacements along a curved cloud chamber track, compared with the direct plot, for the separation of single scattering deflections and track distortions is pointed out. An example is quoted in which the observed scattering is many times the theoretical value. J. G. W.

537.542

4042. The velocity of discharge propagation in Geiger counters. Knowles, A. J., Balakrishnan, C. and Craggs, J. D. Letter in *Phys. Rev.*, **74**, 627–8 (*Sept.* 1, 1948).—Describes a new method for measuring the speed of propagation of the Geiger discharge along a counter, and gives preliminary experimental data for H. A few check results with A/alcohol are included. J. D. C.

537.542

4043. The discharge spread in Geiger–Mueller counters. Liebson, S. H. Letter in *Phys. Rev.*, **74**, 694–5 (*Sept.* 15, 1948).—Comments on the difficulty of deducing accurate absorption coefficients of photoionizing radiations from expts. on discharge spread in split-cathode Geiger counters. It is suggested that the results of Alder *et al.* [Abstr. 1548 (1947)] cannot be compared with those of Liebson [Abstr. 3560 (1947)], since the A/alcohol counter fillings in the former work contained air. J. D. C.

537.542

4044. Ionisation in liquid and solid argon. Hutchinson, G. W. Letter in *Nature, Lond.*, **162**, 610–11 (*Oct.* 16, 1948).—Liquid A contained between || plates 1–5 mm apart produced pulses from RaC γ-rays with fields of 10 000 V/cm, corresponding to complete electron collection. Much larger pulses ($\times 12$) were observed in solid A with fields above 13 000 V/cm indicating electron multiplication, but the effect is transient owing to rapid polarization of the cell [cf. Abstr. 3767 (1948)]. R. W. P.

537.542

4045. The performance of a new radio-frequency ion source. THONEMANN, P. C., MOFFATT, J., ROAF, D. AND SANDERS, J. H. *Proc. Phys. Soc., Lond.*, **61**, 483–5 (*Nov.*, 1948).—An efficient source for protons or deuterons is described. By using a glass tube with screened anode and negative probe, atomic recombination is reduced and a large proportion of gas kept in the atomic state when the discharge at 20 Mc/s is operating at 50 W. Up to 87% D_1^+, or 91% H_1^+ can be obtained, 90% of ions having an energy spread of $< \pm 20$ eV with focused currents of $\frac{1}{2}$ mA. J. H. F.

537.542

4046. Pressure regulated thin window Geiger–Mueller counter. TER-POGOSSIAN, M., ROBINSON, J. E. AND TOWNSEND, J. *Rev. Sci. Instrum.*, **20**, 289–90 (*April*, 1949).—The use of very thin Zapon or Formvar windows for G–M counter tubes in β-spectroscopy is limited by the fact that the filling mixture of the counter diffuses or leaks through the window, which forbids the use of very thin windows. A pressure regulator is described which will permit the maintenance of a constant pressure of filling mixture even if the window of the counter allows the slow escape of the gas. A thin window G–M counter presenting some improvements is also described. A.

537.542

4047. The effect of external quenching on the life of argon–alcohol counters. ELLIOT, H. *Proc. Phys. Soc., Lond. A*, **62**, 369–73 (*June*, 1949).—A simple multivibrator for eliminating multiple discharges in argon–alcohol counters is described. This circuit has been used successfully in cosmic-ray intensity recording equipment requiring a high degree of stability. It is shown that the increase in counter life which is observed when a multivibrator of this kind is used is probably due to quenching of the discharge before it has spread the full length of the counter wire. A.

537.542 : 539.16.08

4048. A portable radiation monitor. WYATT, D. G. *J. Sci. Instrum. Phys. Ind.*, **26**, 13–16 (*Jan.*, 1949).—The design and constructional details are given of a portable radiation monitor of the ionization chamber d.c. amplifier type. On the most sensitive range, a 10% meter reading denotes an intensity of 0·01 r./hr for X- and γ-rays over the energy range 100 keV–3 MeV. The ionization chamber has thick air-walls (0·95 cm of Bakelite) for the measurement of γ-radiation, while by using sliding shutters, the wall thickness on one side of the chamber may be reduced for the detection of soft X-rays, or the chamber opened for the checking of α- and β-contamination. A.

537.542 : 539.16.08

4049. A random operated Wilson chamber for low and high pressures. SPAA, J. H. AND SIZOO, G. J. *Physica, 's Grav.*, **14**, 642–9 (*Feb.*, 1949).—A Wilson chamber, with 30 cm diameter, constructed for universal use and operated by air-pressure is described. Details of the construction, the magnetic field, the illumination and the method of operation are given. A.

537.542 : 539.16.08 : 550.822

4050. Measurement of radioactivity and temperature in narrow boreholes, and the development of instruments for this purpose. GUELKE, R., HEYDENRYCH, J. C. R. AND ANDERSON, F. *J. Sci. Instrum. Phys. Ind.*, **26**, 150–2 (*May*, 1949).—The development of instruments for special conditions encountered in S. Africa is described. Special mention is made of size considerations and making the instruments self-contained so as to enable a single insulated wire to be used for hoisting purposes. A.

537.542 : 539.166

4051. Efficiency of γ-ray counters. RENARD, G. A. *J. Phys. Radium* (*Sér.* 8) **9**, 212–17 (*June*, 1948) *In French.*—Using sources of monochromatic radiation the ratio of counted to emitted rays is equated to $\varepsilon\omega \exp(-\mu m/\rho)$, where ω is the effective solid angle of the counter and the exponential term defines the absorption in the counter wall. The efficiency ε of a counter with walls of Al, Cu or Au is determined over the γ-ray energy range 0·3–3 MeV by the method of coincidence using the established nuclear disintegration schemes of Al^{28}, Cu^{61}, V^{52}, Au^{198}. L. E. M.

537.542 : 539.166

4052. Design and performance of a multicellular Geiger counter for gamma-radiation. LIND, D. A. *Rev. Sci. Instrum.*, **20**, 233–5 (*April*, 1949).—The design problems for Geiger counters which have a high γ-radiation sensitivity are discussed. A description of a counter consisting of 9 individual counters in the shape of pill-boxes mounted inside a single envelope is given. The individual pill-boxes are 3 in. in diameter. The anode has the shape of a four-pronged spider which is centred in the box. The 9 section counter has a flat plateau of about 150 V, and intrinsic sensitivity of 25%. Its lifetime is $> 10^7$ counts. A.

537.542 : 539.172.4

4053. An apparatus for measuring the energies of fission fragments obtained by slow and fast neutron bombardment. SIMONS, L. AND GROTENFELT, B. *Comment. Phys. Math., Helsingf.*, **13** (*No.* 9) 9 *pp.* (1948) *In English.*—Gives a description of a parallel-plate argon ionization chamber with amplifier and recorder. F. LL. J.

537.542 : 578.088.5

A method of estimating the time at which a counting rate changes, using a G.M. counter. *See Abstr.* 4361

537.547

4054. Electrode ionization processes and spark initiation. JONES, F. L. *Proc. Phys. Soc., Lond. A*, **62**, 366–76 (*June*, 1949).—Spark time lags in short gaps with W electrodes were measured for different degrees of oxidation and activation, and the distributions of lags examined and compared. The results, which showed a reduction of mean lag and a narrowing of distribution following oxidation and activation, are discussed in relation to the mechanism of electron emission from oxidized cathodes for impulse and static conditions, and also for the Geiger counter. A.

IONIZATION . THERMIONICS 537.56/.58

537.562 : 537.525.8

4055. Determination of the Townsend coefficients in mercury vapour. BADAREU, E. AND BRĂTESCU, G. G. *Bull. Soc. Roumaine de Phys.*, **45** (*No.* 82) 9–25 (1944) *In French.*—Townsend's α and γ coefficients were determined in Hg vapour with Fe electrodes over the pressure range 2·16–5·46 mm Hg, for x/p varying between 150 and 1 400 V/cm/mm Hg. A brief discussion of the results is given, particularly of η ($= x/\alpha$), the mean energy necessary for an electron to ionize the vapour. J. D. C.

537.562 : 537.525.8

4056. A contribution to the study of Townsend's γ coefficient. BRĂTESCU, G. G. *Bull. Soc. Roumaine de Phys.*, **45** (*No.* 82) 27–31 (1944) *In French.*—The variation of γ with x/p in the results of the experiments in Hg vapour [Abstr. 4055 (1948)] is discussed in terms of (*a*) the mechanisms of secondary electron liberation from the cathode due to positive ion impact and (*b*) photo-emission from the cathode. It is concluded that the latter is important, since γ (Fe cathode) tends to increase at low values of x/p. J. D. C.

537.564

4057. The Townsend coefficients for cyclohexane vapour. VALERIU-PETRESCU, M. *Bull. Soc. Roumaine de Phys.*, **44** (*No.* 81) 3–7 (1943) *In French.*—Measurements of Townsend's α and γ coefficients were made over the press. range 0·5–3·12 mm Hg for x/p (field strength/pressure) varying from 400 to 3 000 V/cm/mm Hg. At $x/p = 1\,000$ (above units), $\alpha/p = 26{\cdot}6$. Gap lengths ranged from 0·06 to 0·34 cm, the γ data were found for an Al cathode and, e.g., for $x/p = 1\,000$ (above units), $\gamma = 10^{-6}$. J. D. C.

537.583

4058. Thermionic constants of polycrystalline metal. ARIZUMI, T. *J. Phys. Soc. Japan*, **3**, 1–7 (*Jan.-Feb.*, 1948) *In English.*—The thermionic constants of a metal vary from crystal face to crystal face. The effect of this on the emission from a polycrystalline wire is considered in an attempt to correlate the experimental values with observations on single crystals. It is shown that the average work function and average A become functions of temperature. A simple case of two widely different work functions is discussed, yielding a qualitative explanation of the shape of the $\phi \sim A$ curve obtained during the activation of thoriated W. A. H. W. B.

537.583

4059. Free barium and the oxide cathode. JENKINS, R. O. AND NEWTON, R. H. C. *J. Sci. Instrum. Phys. Ind.*, **26**, 172–4 (*May*, 1949).—It is shown that the greater part of the free Ba produced by a modern oxide-coated cathode is formed through chemical reduction by the impurities in the Ni core. The actual amount of free Ba retained by the cathode may be only $\sim \frac{1}{10}$ of that produced, the rest being evaporated on to other electrodes. There appears to be a lower limit to the rate of production at a given temp., below which the emission cannot be maintained at a high level. The free Ba concentration in a well-activated coating is $\sim 0{\cdot}01\%$ or 3×10^{17} atoms/cm^3. A.

COSMIC RAYS 537.591

537.591

4060. Tracks in emulsions at 100 000 feet. SALANT, E. O., HORNBOSTEL, J. AND DOLLMANN, E. M. Letter in *Phys. Rev.*, **74**, 694 (*Sept.* 15, 1948).—Ilford C2, 50 μ unloaded nuclear emulsions were exposed at 100 000 ft where temp. range is +20 to −60°C. Control experiments established that grain density at −60°C is about $\frac{1}{3}$ < at +20°C. It was found that stars of many tracks become relatively more abundant compared with small stars, and meson phenomena less abundant than at about 10 000 ft altitude. Both effects are considered to be consistent with the greater energy associated with the single events at great height. J. G. W.

537.591

4061. Cloud-chamber equipment for study of infrequent cosmic-ray processes. CHANG, W. Y. AND WINCKLER, J. R. *Rev. Sci. Instrum.*, **20**, 276–85 (*April*, 1949).—The cloud chamber described operates if a particle passes through a vertical telescope and stops before reaching anticoincidence counters under the chamber. The chamber is surrounded by a minimum amount of material, and a large number of the anticoincidence events consist of particles stopping in foils of Al, Fe and Pb within the chamber. The expansion valve is of the fast electromagnetic type having a thin Fe diaphragm which completes a magnetic circuit when closed. 6 slow expansions for clearing the chamber occur immediately after each event. The chamber is housed in an insulated room kept within ±0·1°C. The Geiger counter coincidence circuits operate time delays for controlling the expansions, flash lamps, camera, clearing field, and recorders. The electronics is suitable for the study of very infrequent events. Several pictures of meson decay and shower events are presented. A.

537.591 : 551.593.9

A possible contribution to the light of the night sky from cosmic rays. *See Abstr.* 4347

537.591.1

4062. Plasma oscillations as a cause of acceleration of cosmic-ray particles. BOHM, D. AND GROSS, E. P. Letter in *Phys. Rev.*, **74**, 624 (*Sept.* 1, 1948).—The acceleration of cosmic-ray particles by a process in which particles are trapped in potential wavefronts of increasing wave velocity arising from plasma oscillation in the intragalactic ion gas is examined. It is considered that adequate energy to maintain the oscillation can be derived from photoionization by starlight. J. G. W.

537.591.1

4063. Stellar magnetic fields and cosmic rays. DAUVILLIER, A. *C.R. Acad. Sci., Paris*, **227**, 1003–4 (*Nov.* 15, 1948) *In French.*—Type *A* stars for which Babcock [Abstr. 3032 (1947)] has described large magnetic fields changing in polarity in times of the order 10 days, are considered as a source of charged cosmic-ray particles. J. G. W.

537.591.1

4064. Origin of cosmic rays. DUNGEY, J. W. AND HOYLE, F. Letter in *Nature, Lond.*, **162,** 888 (*Dec.* 4, 1948).—The conditions under which magnetic fields within the galaxy can lead to an isotropic distribution of charged cosmic-ray particles from isolated sources in the galaxy are shown to require magnetic fields ⩾ any which have been proposed. The observed isotropic distribution of energy density $\sim 10^{-13}$ ergs/cm^3 must therefore extend to internebular space. J. G. W.

537.591.1 : 523.823

4065. Magnetized stars as induction accelerators producing cosmic rays. TERLETZKI, Y. P. Letter in *J. Exp. Theor. Phys., USSR,* **18,** 479 (*May*, 1948) *In Russian.*—Babcock's determination of the magnetic field on the surface of some rapidly revolving stars [Abstr. 2755 (1947)], together with the author's hypothesis [Abstr. 1107 (1947)] that cosmic radiation might issue from revolving magnetized stars, seem to be in good mutual agreement. Of particular interest is the confirmation of Blackett's relation for the star 78 Vir. [Abstr. 1715 (1947)], as well as for sun and earth. On the author's theory, the energy of particles of electron charge so accelerated would be $\sim 10^{12}$ eV which, while far > average energy of cosmic rays, may still be regarded as in favour of the two complementary theories. B. F. K.

537.591.15

4066. On the origin of air showers. HÖCKER, K.-H. *Z. Naturforsch.*, **3a,** 182–4 (*March*, 1948) *In German.*—The angular distribution of extensive air showers reported by Deutschmann [Abstr. 2931 (1947)] is referred to 2 distinct types of shower separated at approximately 45° to the vertical. The more nearly vertical showers arise from electrons, present near the top of the atmosphere; the inclined showers are considered to be secondary to mesons of high energy which themselves arise from the decay of a neutral component. J. G. W.

537.591.15

4067. Directional intensity of cosmic rays at high altitudes. WINCKLER, J. R., STROUD, W. G. AND SCHENCK, J. Letter in *Phys. Rev.*, **74,** 837–8 (*Oct.* 1, 1948).—Counter telescopes with from 0 to 16 cm Pb absorber, at 5 zenith angles from vertical to horizontal, and in measured azimuths, were flown to 100 000 ft. The altitude-intensity relation for inclined telescopes is approx. obtained by an air path transformation of the vertical distribution, both as regards hard and soft components. No azimuthal variation outside the error of experiment was found. The penetration in Pb increased with height, and, at low pressure, most of radiation is either very penetrating or leads to penetrating particles in the absorber. J. G. W.

537.591.15

4068. On the lateral extension of Auger showers. SINGER, S. F. Letter in *Phys. Rev.*, **74,** 844 (*Oct.* 1, 1948).—The importance of inclined extensive showers at large separation [Skobeltzyn, Zatsepin and Miller, Abstr. 1560 (1947)] was examined by comparing the counting rate of two counters separated by 40 m when their axes were respectively along and perp. to the line joining them. J. G. W.

537.591.15

4069. On the production of showers of penetrating particles. MEYER, H. A., SCHACHHEIM, G. AND WATAGHIN, A. Letter in *Phys. Rev.*, **74,** 846–7 (*Oct.* 1, 1948).—Mass equivalent distributions of H_2O and Fe were placed above a Wataghin penetrating shower unit. The cross-section per nucleon for showers is greater in H_2O than in Fe and in each approaches saturation in 57 gm/cm². Difference between H_2O and Pb may be in constitution, multiplicity or angular divergence of showers. J. G. W.

537.591.15

4070. Differentiation of the components of cosmic rays in the low atmosphere and the [relative] frequency of slow mesons. SALVINI, G. *Nuovo Cim.*, **5,** 213–34 (*Aug.*, 1948) *In Italian.*—The experimental distinction between slow mesons and electrons is discussed, and in particular the effect of slow electrons not leading to cascade multiplication when this property is used as a distinctive feature. The absorption curve of mesons up to 300 MeV/c momentum at sea level and at 2 100 m altitude has been measured, and also the electron intensity at the same stations. J. G. W.

537.591.15

4071. Latitude effect of penetrating cosmic ray showers. APPAPILLAI, V. AND MAILVAGANAM, A. W. Letter in *Nature, Lond.*, **162,** 887–8 (*Dec.* 4, 1948).—Observations of penetrating-cosmic ray showers were made at Colombo (geomag. lat. 4° S, sea-level) with an apparatus of the type described by Broadbent and Janossy [Abstr. 2929 (1947)]. Transition measurements up to 24 gm/cm² paraffin show that the gradient of the transition curve for local penetrating showers is of the same order as that at Manchester. An indication of a transition effect for extensive penetrating showers was also obtained. J. G. W.

537.591.15

4072. Momentum spectrum of the particles in extensive air showers. MITRA, S. M. AND ROSSER, W. G. V. *Proc. Phys. Soc., Lond. A,* **62,** 364–9 (*June*, 1949).—An account is given of experiments on the momentum spectrum of the particles in extensive air showers at sea-level. The results are consistent with an integral spectrum of the form $N(>E) \propto (E + E_c)^{-(1\cdot1 \pm 0\cdot3)}$, where E_c is the critical energy in air. Penetrating particles are found in some of the denser showers, the ratio of penetrating particles to electrons being $(0\cdot8 \pm 0\cdot4)\%$. A.

537.591.3

4073. On the absorption spectrum of cosmic rays. KELLERMANN, E. W. AND WESTERMAN, K. *Proc. Phys. Soc., Lond. A,* **62,** 356–63 (*June*, 1949).—It is pointed out that none of the usual methods, i.e. the determination of the number of coincidences as a function of the absorber thickness, can be satisfactory unless the influence of the geometry through scattering is known. Only then can this (integral) absorption curve be used for the determination of the momentum spectrum. A method of determining directly the differential absorption curve is described which avoids largely the influence of scattering. This method has been used for the investigation of some specific effects which have been observed by some and denied by other authors. In particular, the region of 12 cm Pb

has been investigated, and it is found that the change of absorption observed here is due solely to the overlapping of the high momenta end of the electron spectrum and of the meson spectrum. Although the present investigation cannot confirm it, it does not exclude the possibility of a specific change of the absorption coefficient in the 22 cm Pb region. A.

537.591.5

4074. Sidereal variations of cosmic rays. HOGG, A. R. Letter in *Nature, Lond.*, **162**, 613 (*Oct.* 16, 1948).—An analysis of the first harmonic of the apparent solar diurnal variations of cosmic rays over a period of 5 years at Canberra is compared with results at London due to Duperier. It is concluded that the results are not to be interpreted in terms of a 24 hr sidereal variation. J. G. W.

537.591.8

4075. Study of multiple ionization track spectra on photographic plates exposed to cosmic rays at different altitudes. CHOWDHURI, B. *Trans. Bose Research Inst., Calcutta*, **16**, 47–62 (1944–46).—The emission of different kinds of particles when atomic nuclei are struck by fast protons of energy about 10 MeV and the frequency distribution of stars of different multiplicities in photographic plates exposed to cosmic rays are discussed. Ilford half-tone plates were exposed to cosmic rays at altitudes of 7 000, 12 000 and 14 500 ft under different absorbers, e.g. air, water, paraffin and Pb. Tracks having a mean grain spacing $< 2{\cdot}4\,\mu$ are assigned to protons and α-particles, others mainly to mesons. Multiplicity of tracks and absorption investigations tend to verify the Hamilton, Heitler and Peng theory that the primary cosmic particles are protons. P. A.

537.591.8 : 539.18

4076. Differential spectrum of low energy mesons. ROGOZINSKI, A. AND LESAGE, M. *C.R. Acad. Sci., Paris*, **227**, 1027–9 (*Nov.* 15, 1948) *In French.*—The differential range spectrum in Pb of cosmic-ray particles was measured using anticoincidence methods and with counters in anticoincidence to reduce the recording of shower particles. A differential layer of 4 cm Pb was used and all but 4 cm of the main absorber was above the whole apparatus. On a momentum scale a minimum of the spectrum is obtained at 450 MeV/cm in disagreement with results of other workers [Abstr. 3810 (1948)]. J. G. W.

537.591.8 : 539.18

Absorption of meson-producing nucleons. *See Abstr.* 4162

MAGNETISM 538

538.082 : 621.317.44

4077. Erratum: Cathode-ray magnetization curve tracer. SCHERB, M. V. *Rev. Sci. Instrum.*, **19**, 674 (*Oct.*, 1948).—See Abstr. 627 (1949).

538.1

4078. Note on classical magnetostatics. OTT, H. *Z. Naturforsch.*, **3a**, 422–5 (*July*, 1948) *In German.*—Draws attention to the fact that, while the field of an elementary magnet in a homogeneous medium of permeability μ is $\mu_0/\mu \times$ its value in a vacuum, the field of a given Amperian molecular current is independent of μ. It is shown that the reaction of the surrounding medium on a molecular current alters its value in the ratio μ_0/μ so that it behaves similarly to an elementary magnet. In a non-homogeneous medium a molecular current is only completely equivalent to an elementary magnet if its dimensions are indefinitely small. C. E. W.

538.11 : 530.1

Rotation and magnetism. *See Abstr.* 3743

538.11 : 530.1

Magnetism of celestial bodies and gravitation. *See Abstr.* 3744

538.11 : 536.7

4079. The thermodynamics of magnetization. GUGGENHEIM, E. A. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 3) 476 (1949).—A reply to criticisms by Livens [Abstr. 257 (1949)] of a paper by the author [Abstr. 2879 (1936)].

538.114 : 539.152.1

4080. Nuclear ferromagnetism. FRÖHLICH, H. AND NABARRO, F. R. N. *Rep. Internat. Conf.* "*Low Temperatures*" (1946) *Phys. Soc., Lond.*, **II**, 130–4 (1948).—It is shown that at temperatures of the order of 10^{-6} ° Å metals should become ferromagnetic owing to the parallel orientations of their nuclear spins. Such ferromagnetics would have a domain structure analogous to that of ordinary ferromagnetics. A. E. DE B.

538.22 : 535.371

4081. Some magnetic properties of manganese-activated luminescent solids. JOHNSON, P. D. AND WILLIAMS, F. E. *J. Chem. Phys.*, **17**, 435–8 (*May*, 1949).—The specific susceptibilities of a series of Mn-activated ZnF phosphors and their components have been measured. The unexcited Mn was found to be in the divalent ^6S state. There is evidence for exchange demagnetization of adjacent paramagnetic activator ions. The change in paramagnetic susceptibility with excitation, predicted by Williams and Eyring [Abstr. 2106 (1947)] to explain the long non-temperature-dependent lifetimes of the emitting states of luminescent solids containing paramagnetic activators, has been measured for Mn-activated ZnF. Radiation from a high voltage discharge lamp was used to excite the phosphor in a vacuum magnetic balance having a sensitivity of 10^{-6} dyne/mm scale deflection. The observed change in susceptibility corresponds to a decrease of the order of magnitude of one Bohr magnetron per excited activator ion. A.

538.22 : 541.68

4082. Diamagnetism of phosphonium compounds. CROATTO, U. AND SCATTURIN, V. *Ric. Sci.*, **18**, 113–15 (*Jan.–Feb.*, 1948) *In Italian.*—Susceptibilities of powdered PH_4I and PH_4Br are reported and shown to differ by the amount expected from ionic considerations. Comparisons with analogous ammonium, alkali and alkali earth halides are noted. N. F. A.

538.221

4083. The temperature-dependence of ferromagnetic properties as a basis for research on the physical properties of metals. GERLACH, W. *Metallforsch.*, **2**, 275–80 (1947) *In German.*—The results of recent investigations on the temp.-dependence of charac-

teristic ferromagnetic properties, particularly remanence, coercive force and initial susceptibility, are discussed. The percentage remanence is independent of temp. when no change in structure occurs. Above $T/\Theta = 0{\cdot}6$ the coercive force has the same temp. dependence for all ferromagnetic materials. Below this temp. H_c for Ni crystals falls sharply, but for Au–Ni alloys and for sintered Ni it rises rapidly, owing to the formation of special structures in the alloy or metal. In general, initial susceptibility curves, hysteresis loops and ideal alternating field curves are transformable into one another at certain temp., and non-transformability indicates alterations in crystal structure due to temp. changes. It is concluded that a systematic study of the temp.-dependence of ferromagnetic properties is of importance in research on the physical properties of metals. M. A.

538.221

4084. On the theory of formation of ferromagnetic superlattice alloys. Sato, H. *J. Phys. Soc. Japan*, **3**, 91–2 (*Jan.–Feb.*, 1948) *In English.*—A short note on a theoretical treatment, based on the Bragg–Williams approximation, of the β-brass type of superlattice. An expression is given for the free energy of the system and a further approximation is then suggested whereby the relations between the configurational and magnetic components of the free energy may be deduced. These indicate the essential features of the anomalous characteristics of superlattice alloys such as Ni_3Mn, Ni_3Fe, Fe_3Al and FeCo. H. J. H. S.

538.221

4085. On the inertia of the walls between Weiss domains. Döring, W. *Z. Naturforsch.*, **3a**, 373–9 (*July*, 1948) *In German.*—It is shown that the energy of a boundary wall between two domains in a ferromagnetic is increased when the wall moves. The increase is $\propto$ the square of the velocity of the wall. This effect will influence the dispersion of permeability at high frequencies. A. E. De B.

538.221

4086. Microwave magnetic dispersion in carbonyl iron powder. Birks, J. B. Letter in *Phys. Rev.*, **74**, 843–4 (*Oct.* 1, 1948).—The complex permeability of Fe of particle size $5{\cdot}5\ \mu$, in paraffin wax, was measured from 60–3 cm and extrapolated to zero dilution. The results correspond closely to the theoretical treatment of Kittel [Abstr. 137 (1947)] for thin films. D. H. W.

538.221

4087. Magnetization curves of ferromagnetic single crystals. Lawton, H. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 145–56 (1949).—A continuation of previous work [Abstr. 1281 (1948)]. The case now considered is that of oblate spheroids of Fe and Fe–Si where the equatorial plane is a (110) plane of the crystal, and the magnetic field is applied in this plane. Calculations are made for the component of magnetization perpendicular to the applied field, and the results are compared with experiment [Abstr. 1668 (1941)]. L. S. G.

538.221

4088. Measurements on gyromagnetic resonance of a ferrite using cavity resonators. Beljers, H. G. *Physica, 's Grav.*, **14**, 629–41 (*Feb.*, 1949) *In English.*—The phenomenon of gyromagnetic resonance is measured with a resonant cavity, using small spheres and a thin ring made of "Ferroxcube 4," a nickel-zincferrite. Samples are placed in a cylindrical cavity at the electric nodal circle of the mode E_{020}. Resonance-frequency shift and quality are measured for various values of the axial magnetic field H. Some experimental values for the gyromagnetic ratio are deduced. The g factor was found to be 2·12. Making some simplifying assumptions the above-mentioned relation between H and the complex $\Delta\alpha$ is calculated and compared with the experimental curve. As would be expected, no quantitative agreement for all values of the magnetic field was found. Some maximum values for the internal damping are deduced from the measurements. A.

538.221

4089. Magnetic dispersion at microwave frequencies. Hodsman, G. F., Eichholz, G. and Millership, R. *Proc. Phys. Soc., Lond. B*, **62**, 377–90 (*June*, 1949).—A method is described which has been developed for the measurement of initial permeabilities of ferromagnetic wires in the microwave region and successfully applied over the range from 3 to 13 cm wavelength to a variety of materials. The measurements are carried out by comparing the attenuation of coaxial transmission lines with the ferromagnetic specimen and with a non-ferromagnetic reference material as inner conductors. The attenuation constants are derived from observations on the input impedance of the line for different terminations as embodied in a circle diagram of impedance. The results are interpreted in the light of modern theories of magnetic dispersion and an estimate of domain sizes is made. The limitations of the theoretical treatments are indicated. A.

538.221 : 537.122

Collective electron ferromagnetism. *See Abstr.* 3968

538.222

4090. Contribution to the problem of intersecting straight lines in paramagnetism. Maxim, I. *Bull. Soc. Roumaine de Phys.*, **47** (*No.* 84) 33–40 (1946) *In French.*—Measurements on β-brass containing dissolved Mn show that when the reciprocal of the susceptibility is plotted against temp. the points fall on 2 straight lines intersecting at about 425°c, the temperature at which the order-disorder transition occurs in β brass. A. E. De B.

538.222 : 537.122

Temperature-dependence of paramagnetic susceptibility of a relativistic electron gas. *See Abstr.* 3969

538.222 : 538.569.3

4091. Paramagnetic resonance in copper sulphate. Experimental investigation. Bagguley, D. M. S. and Griffiths, J. H. E. Letter in *Nature, Lond.*, **162**, 538–9 (*Oct.* 2, 1948).—Measurements in H cavities at 3·04, 1·23 and 0·85 cm of the paramagnetic resonance of $CuSO_4 . 5H_2O$ give g values agreeing with the susceptibility. The crystal unit contains 2 non-equivalent Cu ions but with the static magnetic field parallel to the tetragonal axis of one set of Cu ions there is a single broadened resonance

peak, in contrast to $CuSO_4 . K_2SO_4 . 6H_2O$, which is only resolved at 0·85 cm. For resolution the spin exchange frequency must be < the difference in the precessional frequencies of the 2 ions. The exchange frequency $\simeq 0{\cdot}15\ cm^{-1}$. For other field directions the lines are 26–60 gauss wide and show exchange narrowing [see following Abstr.]. D. H. W.

538.222 : 538.569.3

4092. Paramagnetic resonance in copper sulphate. Theory. PRYCE, M. H. L. Letter in *Nature, Lond.*, **162,** 539–40 (*Oct.* 2, 1948).—The line breadth arising from the non-equivalence of the Cu ions is treated by a second-order perturbation theory. The lines are found to be broader, and to possess a non-resonant background, while weak resonance absorption at twice the frequency is permitted. The formula for the exchange line breadth at small frequencies and for $\mu H \ll kT$ is derived, as well as the total line breadth. D. H. W.

538.224 : 537.122

Diamagnetism of a relativistic electron gas. *See Abstr.* 3970

538.23

4093. Examination of hysteresis equations from the standpoint of complex permeability and distortion factor. FELDTKELLER, R. *Z. Phys.*, **124** (*Nos* 7–12) 528–44 (1948) *In German.*—The Rayleigh equation yields expressions for complex permeability and distortion factor which can be examined experimentally. Departures from theory, particularly with silicon-irons, can be explained by taking the Rayleigh constant to be a function of maximum field-strength such that the real and imaginary components bear a constant ratio to one another, and the corresponding development of the equations is given. N. F. A.

538.249 : 536.48 : 539.185

Non-elastic scattering of slow neutrons in ferromagnetics at low temperatures. *See Abstr.* 4168

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3 : 531.51 : 530.12

Electromagnetism and relativity. *See Abstr.* 3756

538.566 : 621.392.26

4094. On the excitation of wave guides. I. SAMARSKI, A. A. AND TIKHONOV, A. N. *Bull. Acad. Sci. URSS, Sér. Phys.* **17** (*No.* 11) 1283–96 (1947) *In Russian.*—The authors examine the excitation of cylindrical waveguides of arbitrary cross-section by a linear current parallel to the axis. The Hertz vector of each current element is obtained by means of an infinite series involving the eigenfunctions of the guide cross-section. The total Hertz vector is then derived using the principle of superposition. The analysis is carried out on a rigorous mathematical basis and an extensive use is made of the properties of Green's functions. F. B.

538.566 : 621.392.26

4095. On the excitation of wave guides. II. SAMARSKI, A. A. AND TIKHONOV, A. N. *Bull. Acad. Sci. URSS, Sér. Phys.*, **17** (*No.* 12) 1432–40 (1947) *In Russian.*—Generalization of Part I, in so far as no restriction is made of the orientation of the exciting current. An elementary current of arbitrary direction is first considered. The electric and magnetic field components parallel to the axis of the guide are derived from the series obtained in Part I, and from there the general electromagnetic field is deduced. The result obtained can then be used to derive by superposition the waves excited in waveguides by any linear current, sheet current or volume current. F. B.

538.566 : 621.392.26 : 621.385

4096. Relativistic deductions on the propagation of the electromagnetic field in a waveguide. CARRARA, N. *Nuovo Cim.*, **5,** 249–62 (*Aug.*, 1948) *In Italian.*—The field in a waveguide is studied in a system of reference moving along the axis of the guide. The method may be applied to the problem of the velocity modulation of a beam of electrons along the same axis. L. P.

538.566.2 : 523.72 : 621.396.11

4097. On the propagation of waves in an inhomogeneous medium. RYDBECK, O. E. H. *Trans. Chalmers Univ. Tech., Gothenburg* (*No.* 74) 33 *pp.* (1948) *In English.*—A mathematical paper in which methods of calculating the propagation of electromagnetic waves in both slightly and strongly inhomogeneous media is discussed. First and higher order approximations for the reflection coefficient for slightly inhomogeneous media are given. The application of the circuit relation of the wave equation is considered in two particular cases, viz. magneto-hydrodynamic waves in the solar atmosphere and the duct propagation of micro-waves in the lower troposphere. W. J. G. B.

MAGNETIC EFFECTS 538.6

538.613 : 535.56–14

4098. On the Faraday effect at microwave frequencies. WILSON, M. C. AND HULL, G. F., JR. Letter in *Phys. Rev.*, **74,** 711 (*Sept.* 15, 1948).—By observing the rotation of the h.f. fields in a $TE_{1,1}$ wave in a circular guide on the application of a static magnetic field (⩽ 1 350 gauss) the Verdet constants of $MnSO_4 . H_2O$ and $MnCl_2 . 4H_2O$ were measured at 3·3 cm wavelength. The rotations of the order of 50′ were ∝ the static field strength and the length of the filling (about 30 cm). The Verdet constant $R = 1{\cdot}9 \times 10^{-3} \pm 30\%$ for $MnCl_2 . 4H_2O$. Many common liquids, water, benzene, alcohol, etc., salts, NaCl, $FeCl_3$, etc., and NH_3 gas gave no detectable effect, $R < 0{\cdot}5 \times 10^{-3}$. D. H. W.

538.632

4099. Hall and Kerr effects at microwave frequencies. COOKE, S. P. Letter in *Phys. Rev.*, **74,** 701–2 (*Sept.* 15, 1948).—A resonant cavity method is described for studying the Hall effect at microwave frequencies; in these conditions the effect is equivalent to the optical Kerr effect. Results have been obtained on Bi, Fe, Ni and various other alloys and metals; the observed effects are not in good agreement with

those to be expected from the Hall effect as observed in d.c. conditions. D. S.

538.632

4100. The Hall coefficient as a function of the temperature in compressed bismuth powder. POLARA, V. AND JANNELLI, S. *Ric. Sci.*, **18**, 400–1 (*March–April*, 1948) *In Italian.*—The coefficient passes through a maximum (negative) value as the temperature falls from 0° to −30°c. With increase of field strength (485 to 2 483 oersted) the maximum moves from ~ −20° to −25°c, while numerical values of R are roughly halved. S. T. H.

538.639 : 541.139

4101. An electrical effect produced during the corrosion of a metal in a magnetic field. CROATTO, U. Letter in *Ric. Sci. Ricostruz.*, **18**, 626 (*May–June*, 1948) *In Italian.*—The surface layer produced by corrosion acts as a semiconductor. If two points A and B are taken in the layer, such that AB is $\perp$ to the direction of corrosion and also to the magnetic field, there exists a potential difference, v, between A and B, such that $v \propto$ magnetic field strength and distance AB. An example is given showing the order of magnitude of v. L. S. G.

538.652

4102. Motional impedance measurements on a magnetostrictive system. FINLON, F. P. *J. Acoust. Soc. Amer.*, **21**, 177–82 (*May*, 1949).—The motional impedance of a magnetostrictive element [Abstr. 2050 B (1947)] is determined by a method involving embedding of the element in a block of Permafil, a non-magnetic plastic. The method used can be adapted to determine the motional impedance of any odd-shaped magnetostrictive element. The possible application of this method to the determination of magnetostrictive constants is pointed out. A.

538.66 : 537.312.62

Penetration depth of a magnetic field in superconductors. *See Abstr.* 3996

538.662.15

4103. Thermal variation of the coercive field of finely divided cobalt. WEIL, L., MARFOURE, S. AND BERTAUT, F. *J. Phys. Radium* (*Sér.* 8) **9**, 203–7 (*June*, 1948) *In French.*—Specimens of finely-divided Co, obtained by reduction of Co salts, have been examined at temps. between that of liquid air and 300°. The structure of each specimen was examined by X-ray methods and it was found that the amounts of "hexagonal" and "cubic" Co present depended to some extent on the mode of preparation. Specimens rich in "hexagonal" Co show a marked diminution in the coercive field as the temperature rises to 200° and then show a gradual increase in keeping with Néel's theory that the field arises partly from anisotropic grain structure and partly from magnetic anisotropy of the substance. W. R. A.

538.69

4104. Influence on radiation of a homogeneous and longitudinal magnetic field. EHRENHAFT, F. AND HERZOG, R. *C.R. Acad. Sci., Paris*, **227**, 626–7 (*Sept.* 27, 1948) *In French.*—The behaviour of a β-radioactive sample of RaE in a homogeneous and longitudinal magnetic field has been investigated using Al of different thicknesses and determining the extent of blackening on a photographic plate. It appears that the absorbing properties of Al are considerably modified by the field. W. R. A.

MOLECULAR STRUCTURE 539.13

539.132

4105. The normal vibrations of polyatomic molecules as treated by Urey–Bradley field. SIMANOUTI, T. *J. Chem. Phys.*, **17**, 245–8 (*March*, 1949).—A method of setting up the vibrational secular equation for polyatomic molecules of "Urey–Bradley field" type is described. By this method the vibration frequencies of CCl_4, CBr_4, CH_4, CD_4, CCl_3Br, CCl_2Br_2, $CClBr_3$, CCl_3H, CCl_2H_2, $CClH_3$, CCl_3D, CCl_2D_2, $CClD_3$, CH_3D, CH_2D_2 and CHD_3 molecules have been calculated. The 102 fundamental frequencies calculated using 28 distinct force constants are in satisfactory agreement with the observed, with a mean deviation of 1·4%. A.

539.132 : 539.155.2 : 535.338

4106. The isotopic effect of the potential function of molecular states. VALATIN, J. G. Letter in *Phys. Rev.*, **74**, 346–7 (*Aug.* 1, 1948).—A qualitative interpretation of the conclusion of Gerö and Schmid [*Zeit. f. Physik*, **118**, 210, 250 (1941)] that the ground state, $X^2\Pi$, of CD is more stable than that of CH by about 350 cm^{-1} is given. R. F. B.

539.132 : 539.181

On the ammonia molecule. *See Abstr.* 4165

539.133

4107. Determination of position of tracer atom in a molecule: mass spectra of some deuterated hydrocarbons. TURKEVICH, J., FRIEDMAN, L., SOLOMON, E. AND WRIGHTSON, F. M. *J. Amer. Chem. Soc.*, **70**, 2638–43 (*Aug.*, 1948).—CH_3D, CD_4, C_2H_5D, $CH_3 . CH_2 . CH_2D$ and $CH_3 . CHD . CH_3$ have been prepared and their mass spectra determined using 2 different mass spectrometers. A method of calculating the mass spectra of CH_3D and C_2H_5D from the corresponding protium analogues is indicated. The position of D in the deuterated propanes should be revealed from the mass spectra of the fragment ions produced on account of rupture of different valency bonds but determination is found to be difficult. W. R. A.

539.133

4108. The moment of inertia of CF_3CH_3. EDGELL, W. F. Letter in *J. Chem. Phys.*, **16**, 1002 (*Oct.*, 1948).—The M.I. perpendicular to the threefold axis was experimentally found to be $161{\cdot}80 \pm 0{\cdot}07 \times 10^{-40}$ g cm² in the ground state, and $162{\cdot}04 \pm 0{\cdot}07 \times 10^{-40}$ in the unidentified excited state. These figures are in agreement with the value of $166{\cdot}7 \pm 5{\cdot}8 \times 10^{-40}$, calculated from electron diffraction measurements [see Abstr. 1596 (1944)]. F. L.

539.133

4109. Evidence for the planar structure of the urea molecule. KELLER, W. E. *J. Chem. Phys.*, **16**, 1003–4 (*Oct.*, 1948).—Evidence from i.r. spectra obtained by directing plane-polarized radiation

through orientated urea crystals provides support for the planar structure. C. B. A.

539.133

4110. Note on the theory of ethylene. BUSCH, R. H. Letter in *J. Chem. Phys.*, **16**, 1005 (*Oct.*, 1948).

539.133 : 541.64 : 532.13 : 535.43

4111. Dimensions of coiling polymer molecules from viscosity and light scattering. BUECHE, A. M. *J. Amer. Chem. Soc.*, **71**, 1451–5 (*April*, 1949).—Molecular dimensions for polystyrene fractions in benzene have been obtained from viscosity and light scattering data. It was found that the root mean square of the distance between the ends of the molecule $\simeq$ the diameter of the molecular sphere needed for the explanation of viscosity. Evidence for the absence of appreciable branching or cross-linking in the polystyrene fractions was obtained. Polystyrene molecules in benzene were found to be much stiffer than would be expected from a free-rotation model. This stiffness is responsible for the relatively high viscosities of polystyrene solutions. A.

539.133 : 548.7

4112. On the bond lengths and interatomic distances in certain molecules and crystals. HUME-ROTHERY, W. *Proc. Roy. Soc. A*, **197**, 17–27 (*April* 22, 1949).—The internuclear distances in the crystals of some of the elements at the absolute zero have been calculated, and the values are examined and compared with those in some molecules. In the first two short periods, if the single bond length is denoted D, and the atomic number Z, a direct proportionality exists between D^2 and Z for the members of any one group from group IV to group VII. In groups IV to VII this proportionality extends to the corresponding elements of the first long period, so that, for example, the D^2 values for C, Si and Ti are proportional to Z. In group III the D^2 value for B and the square of the internuclear distance in the crystal of Al are proportional to Z, but the proportionality does not extend to Sc, and in groups I and II no proportionality exists between D^2 and Z. Simple whole-number relations are found between the squares of the internuclear distances in the earlier members of group II, and other regularities are pointed out. Evidence is also given for the hypothesis that simple whole number relations exist between the squares of the bond lengths of single, double and triple bonds of a given element. A.

ATOMIC STRUCTURE . ISOTOPES 539.15

539.15

4113. The relation between covalent and packing radii of atoms. REES, A. L. G. Letter in *J. Chem. Phys.*, **16**, 995–6 (*Oct.*, 1948).—Pauling's empirical rule connecting the packing radius (r) and the single-bond covalent radius (r'), viz. $r = r' + 0{\cdot}8$ Å, is very approx. since from X-ray crystallographic data $r - r'$ varies from 0·4 to 0·9 Å. From recent calculations of electron density distributions in covalently bound atoms a relationship $r^2 = r'^2 + k^2$, where k is the radius of the circular contact area in the plane perpendicular to the internuclear line. The mean value of k for H, O, Br, I, Se and Te is 1·22 Å and this is used to calculate r. It is also shown that the packing radii for the same atom singly and doubly covalently bound are identical. W. R. A.

539.152.1

4114. Wefelmeier's model of the higher atomic nuclei. HÖCKER, H. *Z. Naturforsch.*, **3a**, 365–9 (*June*, 1948) *In German.*—The atomic model due to Wefelmeier, which regards the nucleus as a type of crystal made up of α-particles, which are themselves spherical, has been applied to the heavier nuclei. Some difficulties arise in connection with energy considerations. A. J. M.

539.152.1

4115. On models for Be^9. GUTH, E. AND MULLIN, C. J. Letter in *Phys. Rev.*, **74**, 832–3 (*Oct.* 1, 1948).—Although not as accurate as the Hartree approximation or an α-particle ($2\alpha + n$) model, a 2-body model of Be^9 (i.e. $Be^8 + n$) is probably justified by the low binding energy of the last neutron and the instability of Be^8. Assuming a $^2P_{3/2}$ level as lowest the magnetic moment given by the model is $-1{\cdot}85$ magnetons. By analogy with He^5 and Li^7 the $^2P_{\frac{1}{2}}$ level should also represent a bound state. G. J. K.

539.152.2 : 535.343.4–14

4116. Spin and quadrupole moment of S^{33}. TOWNES, C. H. AND GESCHWIND, S. Letter in *Phys. Rev.*, **74**, 626–7 (*Sept.* 1, 1948).—Using a Stark modulation system at 200 kc/s and a lock-in amplifier a fine structure was observed to the $J_{1\to 2}$ transition of OCS^{33} near 24 020 Mc/s, the weakest line having an absorption coeff. of $2{\cdot}5\times10^{-9}$ neper/cm. The spin of S^{33} is found to be 3/2, the quadrupole coupling constant $-28{\cdot}5 \pm 0{\cdot}7$ Mc/s, and the quadrupole itself $-0{\cdot}05\times10^{-24}$ cm² within a factor of 2. The mass-ratio $(S^{33} - S^{32})/(S^{34} - S^{32})$ is $0{\cdot}50066 \pm 0{\cdot}00015$, in agreement with the value from nuclear reaction energies. Rotation-vibration constants and the l-type doubling constant of OCS^{34} are also given. D. H. W.

539.153

4117. The Thomas–Fermi atom deduced by a variation principle. ALLARD, G. *J. Phys. Radium* (*Sér.* 8) **9**, 225–9 (*July–Aug–Sept.*, 1948) *In French.*—The equations are obtained from an expression for the total energy by a variation method. A generalization due to Fock and modified by Dirac can also be included, and leads to the same equations but with an extra condition. It is noted that the total ionization energy of atoms He to O is given by $W = -15{\cdot}73\,Z^{7/3}$ eV to within 1%, giving the same variation with Z as for the heavy atoms. G. J. K.

539.154.2

4118. The present-day periodic system. ZIMENS, K.-E. *Trans. Chalmers Univ. Tech., Gothenburg* (*No.* 78) 18 *pp.* (1948) *In Swedish.*—Brief history of the Periodic System from Meyer and Mendeleyev to the present day, including the elements 43, 61, 85, 87, 93, 94, 95 and 96. The known chemical properties are noted. An arrangement is suggested for the whole system, including isotopes and radioactive series. H. H. HOP.

539.154.2

4119. Further notes on a scheme for the chemical elements. MEYER, S. AND KOSS-ROSENQVIST, A. *Acta Phys. Austriaca*, **2** (*No.* 3) 245–54 (1949) *In German.*—The new arrangement of the elements recently put forward [Abstr. 1525 (1949)] explains the existence and nature of nuclei with equal charges (isotopes), equal neutron content (isotones) and equal masses (isobares). The table provides confirmation of gaps occurring in the present-day list of nuclei and for the existence or special nature of the nuclei $_{20}Ca^{48}$, $_{37}Rb^{87}$, $_{50}Sn^{115}$, $_{51}Sb^{123}$, $_{54}Xe^{136}$, $_{62}Sm^{147}$, $_{76}Os^{184}$ and $_{80}Hg^{196}$. A. J. M.

539.154.2

4120. Harmonic system of elements. BEDREAG, C. G. *Bull. École Polyt. Jassy*, **3**, 37–43 (*Jan.–June*, 1948) *In French.*—A new table of elements is proposed based on the tables of 18 columns (Lothar Meyer, Thomson, Werner-Pfeiffer) plus one column for the rare earth metals and another for the transuraniums. Tables by Slater, Seaborg and Meggers are considered to be inaccurate and misleading. F. L.

539.155.2

4121. Relative abundance of the isotopes of tin. HINTENBERGER, H., MATTAUCH, J. AND SEELMANN-EGGEBERT, W. *Z. Naturforsch.*, **3a**, 413–15 (*July*, 1948) *In German.*—A redetermination of the relative abundance of the Sn isotopes has been carried out by an electrometric method with the following results: 112 (0·94%), 114 (0·65%), 115 (0·33%), 116 (14·36%), 117 (7·51%), 118 (24·21%), 119 (8·45%), 120 (33·11%), 122 (4·61%), 124 (5·83%). These values differ considerably from those obtained photometrically by Aston. Using the above relative abundances, the mass number is $118{\cdot}826 \pm 0{\cdot}009$, which, with a packing fraction of $-5{\cdot}07 \pm 0{\cdot}32$ gives $118{\cdot}73 \pm 0{\cdot}01$ for the chemical atomic weight of Sn. The international value is 118·70. The upper limit of the abundance of the isotopes of mass number 110, 111, 113, 121, 123 and 125 is 0·01%. A. J. M.

539.155.2

4122. Oxygen isotopes in nature and in the laboratory. UREY, H. C. *Science*, **108**, 489–96 (*Nov.* 5, 1948).—Factors affecting the relative abundance of isotopes in inorganic compounds are discussed. If calcium carbonate is crystallized slowly in the presence of water, calculation shows that, if the ratio of O^{18} and O^{16} is 1 : 500 originally, the ratio in the crystal will depend slightly on the temp. at which crystallization takes place, varying from 1·026 : 500 at 0°c to 1·022 : 500 at 25°c. Assuming that the isotopic composition of sea water has not changed appreciably during geological time, this small temp. coefficient affords a possible method of estimating the temp. at which marine animals have lived by determining the isotopic composition of their remains, provided it has not varied. Some details are given of a mass-spectrograph for measuring small variations in the relative abundance of isotopes and the preparation of O samples from inorganic animal remains. An empirical temp. scale is established by finding the relationship between the isotopic composition of the shells of present-day animals and the temp. at which they live. For a number of samples a relationship in fair agreement with the calculated coefficient is found but some anomalous results also occur. Estimates of the temps. of the upper Cretaceous seas in Hampshire, England, are made by analysing Belemnites. Values between 17°c and 27°c are found. B. C. B.

539.155.2 : 533.15

The infinite separation tube with reservoirs at the end. *See Abstr.* 3812

539.155.2 : 541.133.1

4123. Shift in abundance of the Cd isotopes by ionic migration in molten $CdCl_2$. KLEMM, A., HINTENBERGER, H. AND SEELMANN-EGGEBERT, W. *Z. Naturforsch.*, **3a**, 172–6 (*March*, 1948) *In German.*—At the boundary between LiCl and $CdCl_2$ the distribution of the abundances of the Cd isotopes was shifted in favour of the lighter isotopes by ionic migration. The duration of the experiment was 50 hr, current density 5·5 A/cm², separation length 12 cm, temp. 630°c. The separation factor of the most highly altered fraction (47 mg $CdCl_2$) was 1·5 for the isotopes Cd^{106} and Cd^{116}. The multiplication factor (number of theoretical plates) was 67. From this follows a mass effect $\mu \equiv \ln({}^{i}w/{}^{k}w)/\ln({}^{i}m/{}^{k}m) = -0{\cdot}067$. Here the w and m are the ionic mobilities and atomic weights of any isotope pair i, k under consideration [see Abstr. 3616 (1947)]. H. L.

539.155.2 : 541.23

Natural variations in the isotopic content of boron. *See Abstr.* 4237

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16

4124. Notes on the main provisions of the Radioactive Substances Act, 1948. BINKS, W. *J. Sci. Instrum. Phys. Ind.*, **26**, 169–71 (*May*, 1949).

539.16 : 614.8

4125. A hood for work with radioactive isotopes. SOLOMON, A. K. AND FOSTER, C. A. *Analyt. Chem.*, **21**, 304–7 (*Feb.*, 1949).

539.16.08

4126. Variations in total counts of P^{32} and I^{131} for dishes of different atomic number. COWING, R. F. AND DEAMICUS, E. *Science*, **108**, 187 (*Aug.* 20, 1948).—Variations as great as 50% have been found in the measurement of radioactive isotopes in different laboratories. Some of the discrepancy is due to the amount of radiation reflected from different materials of which dishes used to measure radiation are made. Results of measurements of the percentage reflection from Al, Cu, Sn and Pb dishes for radiation from P^{32} and I^{131} show this bears a linear relation to Z for the dish, when filter paper is used as a non-reflecting material. T. A. C.

539.16.08 : 537.542

A portable radiation monitor. *See Abstr.* 4048

539.16.08 : 537.542

Universal random-operated cloud chamber. *See Abstr.* 4049

539.16.08 : 550.822 : 537.542

Measurement of radioactivity in narrow boreholes. *See Abstr.* 4050

539.163

4127. Some relations between the disintegration energies of the light radioactive nuclei. NEUERT, H. *Z. Naturforsch.*, **3a**, 152–8 (*March*, 1948) *In German.*—For atomic numbers < 40 it is shown that some simple relations exist between ½-life, disintegration energy, nuclear mass and nuclear spin. The spin-dependent part of the binding energy may be determined from the disintegration energies of a family of nuclei, i.e. nuclei having related numerical properties. It is suggested that the difference between binding energy and the measured disintegration energy is to be attributed to spin forces. F. T. F.

539.163 : 550.367

Significance of the radioactivity of potassium in geophysics. *See Abstr.* 4284

539.163.1

4128. The radioactive lanthanum and cerium isotopes of mass 137. INGHRAM, M. G. AND HESS, D. C., JR. Letter in *Phys. Rev.*, **74**, 627 (*Sept.* 1, 1948).—The isotopic constitution of a sample of CeO_2, 10 months after a prolonged neutron bombardment in a graphite moderated pile, was compared with that of normal Ce using a surface ionization type of mass-spectrometer. A new peak due to La appeared at mass 153 ($La^{137}O^{16}$). Assuming the sequence $Ce^{137} \rightarrow La^{137} \rightarrow Ba^{137}$ it is concluded that the ½-life of Ce^{137} is < 2 weeks, that of $La^{137} > 30$ yr. [But see Abstr. 1713 (1943)]. A. O. S.

539.163.1

4129. The half-life of C^{14}. HAWKINGS, R. C., HUNTER, R. F., MANN, W. B. AND STEVENS, W. H. Letter in *Phys. Rev.*, **74**, 696 (*Sept.* 15, 1948).—The activity of C^{14} in samples of CO_2 has been determined, with care to eliminate errors due to end- and wall-effects in the counters. The ½-life was found (assuming the counters to be $< 95\%$ efficient) to be $\geqslant 6\,100 \pm 200$ yr, which is $\geqslant$ earlier estimates [Abstr. 1305 (1948)]. A. P. F.

539.163.1

4130. The half-life of C^{14}. YAFFE, L. AND GRUNLUND, J. M. Letter in *Phys. Rev.*, **74**, 696–7 (*Sept.* 15, 1948).—A value of $7\,200 \pm 500$ yr was found, using an end-window Geiger counter and sources of Na_2CO_3 on thin Formvar films. Corrections were made for absorption in air and the counter window, and for back-scattering. A. P. F.

539.163.1/.2 : 539.165 : 539.166

4131. Preparation and radiation of U^{237}. MELANDER, L. AND SLÄTIS, H. Letter in *Phys. Rev.*, **74**, 709–11 (*Sept.* 15, 1948).—The β- and γ-radiations of U^{237}, obtained as U^{6+} by irradiating solid uranyl salicylaldehyde–*o*-phenylenediimine with fast Li + *d* neutrons (Szilard–Chalmers reaction : concentration factor > 500) and chemically separated from Np^{239} and UX_1, have been examined. The β-spectrum shows a number of internal conversion lines, masking the continuous spectrum, but an upper limit of 0·23 MeV is estimated, assuming a simple Fermi distribution: the spectrum may be complex. γ-rays of 56·7, 203·9 and 259·9 keV are found, and attributed to two excited levels of Np^{237}. The ½-life is $6{\cdot}63 \pm 0{\cdot}05$ d. A. O. S.

539.163.2

4132. On the radioactivity of Rb^{87}. FAZZINI, T. AND FRANCHETTI, S. *Nuovo Cim.*, **5**, 311–24 (*Aug.*, 1948) *In Italian.*—A 2·1 mg/cm² Rb^{87} source in a He-filled cloud chamber with magnetic field, gave a continuous β-spectrum with end-point $(5{\cdot}6 \pm 0{\cdot}7) \times 10^5$eV. This spectrum seemed to differ markedly from that of allowed transitions. A search for conversion electrons failed to show the existence of γ-rays of energy > 60 MeV. In this experiment an air filling was used and the source was 50 g RbCl. R. W. P.

539.163.2

4133. Notes on the beta-spectra of Y^{90} and Sr^{90}. MEYERHOF, W. E. Letter in *Phys. Rev.*, **74**, 621–2 (*Sept.* 1, 1948).—The spectra were measured in a 180° spectrometer, using a double source ~1 mg/cm² of Y^{90} and Sr^{90} in secular equilibrium. Kurie plots gave the end points $2{\cdot}35 \pm 0{\cdot}03$ and $0{\cdot}61 \pm 0{\cdot}01$ MeV for Y^{90} and Sr^{90} respectively. The intensity ratio calculated from the linear extrapolation of the Kurie plots to zero energy was $1{\cdot}04 \pm 0{\cdot}10$. B. R.

539.163.2

4134. Cloud-chamber observations of the decay of tritium. BYATT, W. J., ROGERS, F. T., JR. AND WALTNER, A. Letter in *Phys. Rev.*, **74**, 699 (*Sept.* 15, 1948).—1 575 β-particle tracks from the decay of $_1H^3$ (introduced as tritiated water) were measured in a cloud-chamber operated at atmospheric pressure. The max. track length was 4·12 mm (referred to dry air at 15°c, 760 mm pressure); $E_{max} = 11 \pm 1$ keV [see Abstr. 3887 (1948)]. A. O. S.

539.163.2

4135. Cloud-chamber observation on low energy portion RaE beta-spectrum. WALTNER, A. AND ROGERS, F. T., JR. Letter in *Phys. Rev.*, **74**, 699–700 (*Sept.* 15, 1948).—Comparison projected-range distributions for the β-particles from RaE were obtained (*a*) with a backing of collodion film $\sim 0{\cdot}15\ \mu$ thick (716 tracks) and (*b*) with the RaE deposited electrolytically on a Pt wire. The energy distribution appears to vanish at a small energy [see Abstr. 3621 (1939)]. Concordant results have been obtained in preliminary expts. using the RaE in volatile form. A. O. S.

539.163.2

4136. A comparison of the beta spectra of C^{14} and S^{35}. GLENDENIN, L. E. AND SOLOMON, A. K. Letter in *Phys. Rev.*, **74**, 700–1 (*Sept.* 15, 1948).—Feather plots were made of the β-absorption curves in Al, using UX_2 as the standard, and sources $< 0{\cdot}1$ mg/cm² giving extrapolated ranges of $28{\cdot}5 \pm 0{\cdot}5$ and $31{\cdot}7 \pm 0{\cdot}5$ mg/cm² for C^{14} and S^{35} respectively. A constant ratio was observed between the two Feather plots over the whole range of absorption, in disagreement with earlier work with thicker sources [see Abstr. 726 (1948)]. This suggests that these spectra have the same shape above 50 keV. B. R.

539.163.2

4137. Internal conversion pairs in carbon. DOUGHERTY, C. B., HORNYAK, W. F., LAURITSEN, T. AND RASMUSSEN, V. K. Letter in *Phys. Rev.*, **74**, 712 (*Sept.* 15, 1948).—Graphite targets of 57 and

12 mg/cm², respectively, were placed at the position of the source in a magnetic lens β-spectrometer, and were bombarded with 1·2 MeV deuterons. The spectrometer was fitted with helical baffles so that −ve and +ve electron spectra could be separately studied. Besides a yield of Compton electrons almost ∝ target thickness, there appeared approx. equal and constant yields of −ve and +ve electrons, both groups having an upper limit of 2·1 MeV. These ∴ correspond to internal conversion pairs from the 3·11 MeV γ-ray following the process $C^{12}(d,p)C^{13*}$, the yield being $\sim 10^{-3}$ pair per quantum. A. P. F.

539.163.2

4138. The beta spectrum of $Hg^{(203)}_{(205)}$. SAXON, D. Letter in *Phys. Rev.*, **74**, 849–50 (*Oct.* 1, 1948).—The spectrum was measured in a 180° spectrometer. The ½-life was 43·5 ± 0·5 d, in disagreement with earlier work [see Abstr. 1995 (1943)]. The Kurie plot was linear down to 40 keV, showing the allowed shape of the spectrum. The β end-point was obscured by *K*- and *L*-conversion lines from a γ-ray of energy 286 ± 5 keV, but extrapolation of the Kurie plot gave the value 205 ± 10 keV. The energies are in agreement with previous work [see Abstr. 1284 (1947)]. B. R.

539.163.2

4139. The beta-spectrum of S^{35}. ALBERT, R. D. AND WU, C. S. Letter in *Phys. Rev.*, **74**, 847–8 (*Oct.* 1, 1948).—The spectrum was examined with a solenoid spectrometer [see Abstr. 2182 (1941)] and carrier-free S^{35} sources. Fermi plots were linear down to 16 keV for mean source thicknesses of 1 and 2 μg/cm², but significant deviations from linearity occurred below 60 keV for a 5 μg/cm² source. The β end-point was at 166 keV. B. R.

539.163.2

4140. Decay of barium—139. SHEPHERD, L. R. AND HILL, J. M. Letter in *Nature, Lond.*, **162**, 566–7 (*Oct.* 9, 1948).—Investigations were carried out by means of a thin lens β-ray spectrometer and by absorption and coincidence techniques. The extrapolated Fermi end point was 2·27 ± 0·02 MeV and 2 conversion groups had energies of 126 ± 0·5 keV and 159 ± 2 keV, corresponding to the *K* and *L* conversions of a γ-ray of energy 163 ± 0·5 keV. A harder γ-ray of energy 1·05 ± 0·1 MeV, but of low intensity (∼0·6% of the total number of disintegrations compared with 26 ± 3% for the soft γ-ray) was in addition detected in the absorption measurements. R. W. P.

539.163.2 : 539.166

4141. Disintegration of Tc^{95} and Tc^{96}. MEDICUS, H., MUKERJI, A., PREISWERK, P. AND DE SAUSSURE, G. Letter in *Phys. Rev.*, **74**, 839–40 (*Oct.* 1, 1948).—Radiations from Tc^{96} (104 hr) were observed in a magnetic lens β-spectrometer after separation of the Tc from Mo bombarded with 7 MeV protons. Conversion electrons were observed corresponding to γ-rays of 312, 771, 806, 842 and 1 119 keV. From γ–γ coincidence measurements and observed intensities, it was inferred that *K*-capture in Tc^{96} leads to 2 levels in Mo^{96} separated by 312 keV; the lower level emits the 806, 771 and 842 keV quanta in cascade, and the higher level may emit the 1 119 keV γ-ray, or the 312 and 806 keV γ-rays in succession, followed in either case by the 771 and 842 keV quanta. A similar study for Tc^{95} (20 hr) showed γ-rays of 762, 932 and 1 071 keV, but no 200 keV electrons. [See Abstr. 2930 (1948)]. A. P. F.

539.16

4142. New α-radiations in the thorium series. LEIGH-SMITH, A. AND D'AGOSTINO, O. *R.C. Ist. Super. Sanità*, **10**, 523–34 (1947) *In Italian, summaries in French, English, German.*—A repetition of the expt. of Leigh-Smith and Minder [Abstr. 731 (1943)] using a larger RdTh source (90 mg equiv.) apparently confirms the earlier work, but further expts. are being carried out. A. O. S.

539.164.2 : 548.0

4143. The emission of alpha-particles from the different faces of a radioactive crystal. POOLE, J. H. J. AND BREMNER, J. W. Letter in *Phys. Rev.*, **74**, 83 (*Oct.* 1, 1948).—Preliminary results with thorium nitrate crystals, using the photographic emulsion technique, confirm the null results of Mather and Kurie [Abstr. 3901 (1948)] although a small (1–2%) effect would not have been detected. A null result might be expected for U^{238}, Th^{232} which have zero spin and magnetic moment; nuclei without spherical symmetry, such as U^{235}, and presumably U^{233}, Pu^{239} might be profitably examined. A. O. S.

539.16

4144. On the positive particles occurring from P^{32} in the cloud chamber. BARLOW, J. S. AND ROGERS, F. T., JR. Letter in *Phys. Rev.*, **74**, 700 (*Sept.* 15, 1948).—A P^{32} source mounted between two collodion films in the cloud chamber was used to determine whether the number of positrons apparently emitted from β active sources is a function of source mounting. About 0·15% positive particles were observed; it was concluded that this number is not a function of source mounting. J. G. W.

539.165

4145. Dependence of β-decay on the sign of the change in nuclear spin. STRACHAN, C. Letter in *Proc. Phys. Soc., Lond.*, **61**, 481–2 (*Nov.*, 1948).

539.16

4146. On the numerical calculation of the internal conversion in the *K*-shell—the electric dipole case. STANLEY, J. P. *Canad. J. Res. A*, **27**, 17–25 (*March* 1949).—Hulme's formula for the internal conversion of γ-radiation is simplified and used to calculate the internal conversion coefficient in the electric dipole case for electrons in the *K*-shell. For each of the elements $Z = 69, 74, 79, 84, 89$, I_K is calculated for 10 values of the variable $\theta = mc^2/h\nu$ and a table obtained by interpolation is given for $\theta = 0{\cdot}05$ to $\theta = 1{\cdot}70$. A.

539.166 : 537.54

Efficiency of γ-ray counters. *See Abstr.* 4051

539.166 : 537.54

Design and performance of a multicellular Geiger counter for gamma-radiation. *See Abstr.* 4052

539.166.7

4147. Polarization of annihilation radiation. HANNA, R. C. Letter in *Nature, Lond.*, **162**, 332 (*Aug.* 28, 1948).—The Compton scattering of pairs of quanta

from a source of annihilation radiation (Cu^{64} producing $\sim 3\times10^{8}$ positrons/sec initially) has been studied using Geiger counters in coincidence. The results establish the existence of a relative polarization of the annihilation quanta, but further work is required to determine whether or not discrepancies with the theoretical predictions [see Abstr. 3640 (1947)] are due to a breakdown of theory. [See also Abstr. 3906 (1948)]. R. W. P.

NUCLEAR REACTIONS 539.17

539.172.1 : 539.166

4148. Gamma rays from proton bombardment of separated argon isotopes. Brostrøm, K. J., Huus, T. and Koch, J. Letter in *Nature, Lond.*, **162**, 695–6 (*Oct.* 30, 1948).—Targets of A^{40} and A^{36}, deposited by mass-spectrographic technique, were bombarded with protons of 0·5 to 1·8 MeV. 5 capture resonances were found for A^{40}, none for A^{36}. The widths of the resonances are estimated from approx. knowledge of the absolute yields of γ-rays. A. P. F.

539.172.11 : 539.18

4149. The meson output from the bombardment of light nuclei with α-particles. Koppe, H. *Z. Naturforsch.*, **3a**, 251–2 (*April*, 1948) *In German.*—The probability of emissions of a meson following the capture of a fast α-particle ($\sim$400 MeV) in light nuclei is considered in terms of the general temp. of the compound nucleus. J. G. W.

539.172.3

4150. Relative cross-sections for the (γ, n) process with lithium gamma radiation (quantum energy $h\nu = 17{\cdot}5$ MeV). Wäffler, H. and Hirzel, O. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 200–3 (1948) *In German.*—Results are given of measurements on 35 isotopes between N^{14} and Au^{197}, yields of (γ, n) processes being determined by observation of the subsequent β-activity. Besides a general increase of cross-section with Z, there is an abrupt rise between Ca^{40} and Sc^{45}. Values are given relative to Cu^{63}, for which an approx. determination of absolute cross-section ($1{\cdot}2 \pm 0{\cdot}3\times10^{-25}$ cm^2) was made. [See also Abstr. 188 (1948)]. A. P. F.

539.172.3

4151. Theory of the photodisintegration of Be^9. Guth, E. and Mullin, C. J. Letter in *Phys. Rev.*, **74**, 833–4 (*Oct.* 1, 1948).—The experimental curve is obtained using a 2-body ($Be^8 + n$) interacting with a square-well potential of depth 12·16 MeV and range 5×10^{-13} cm in the $^2P_{3/2}$ state. The maximum near the threshold is obtained due to electric dipole $P - S$ transitions and the subsequent minimum. A second maximum due to $P - D$ transitions is to be expected but not yet verified. Measurements at higher energies would confirm the existence of a $^2D_{5/2}$ resonance level, and the angular distribution should decide whether it is justifiable to neglect magnetic dipole effects. G. J. K.

539.172.3

4152. Theory of electro-disintegration of Be^9. Guth, E., Mullin, C. J. and Marshall, J. F. Letter in *Phys. Rev.*, **74**, 834–5 (*Oct.* 1, 1948).—A theoretical calculation is based on the photoelectric effect results [Abstr. 4151 (1949)], assuming that photo-dissociation due to magnetic transitions is unimportant. The result is in good agreement with experiment. G. J. K.

539.172.3 : 539.164

4153. Nuclear photoeffect in carbon with the emission of α-particles. Hanni, H., Telegdi, V. L. and Zünti, W. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 203–4 (1948) *In German.*—Stars formed by 3 α-particles were observed on Kodak Alpha Fine Grain Emulsion plates exposed to the hard γ-rays obtained from fast protons and Li. The energy released in the stars was calculated (by calibration of plates with α-particles from UI and ThC′) to be 10·1 and 7·5 MeV. Stars belonging to both groups are attributed to the reaction $C^{12} + h\nu = 3He^4$. The theoretical energy of the reaction is 10·26 + 0·14 MeV. The 7·5 MeV-group of stars is ascribed to γ-rays with less energy. The energy of α-particles of the first-group stars extends continuously to 5·3 MeV with a max. at 4·7 MeV. Analogous behaviour has been observed with α-particles in the $B^{11}(p, 3\alpha)$-reaction. The present reaction consists probably of 2 steps: (1) $C^{12} + h\nu = Be^{8*} + He^4$; (2) $Be^{8*} = 2He^4$. A few single α-tracks were found whose energies confirm the hypothesis that these tracks are due to the (1) reaction, the excited Be atom decaying instantly to the ground state. F. L.

539.172.4

4154. Investigation of the n–p reaction of phosphorus. Metzger, F., Alder, F. and Huber, P. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 278–88 (1948) *In German.*—The reaction $P^{31}(n,p)Si^{31}$ was investigated, using P_2O_3 in a heatable ionization chamber with 3 MeV neutrons. The energy value of the transition into the ground state is $Q = -0{\cdot}97 \pm 0{\cdot}13$ MeV. An excited level of the final nucleus Si^{31} is located $\sim$0·7 MeV above the ground level. The effective cross-section σ of the reaction increases uniformly with increasing neutron energy, to a max. for 3 MeV neutrons of $\sigma = (7{\cdot}4 \pm 1{\cdot}5)\times10^{-26}$ cm^2. A.

539.172.4

4155. Calculation of some reaction cross-sections for beryllium. Schlögl, F. *Z. Naturforsch.*, **3a**, 229–40 (*April*, 1948) *In German.*—Using a simplified two-body model for Be^9, consisting of a Be^8 core and a loosely-bound neutron, the cross-sections for (γ, n), (n, n) and $(n, 2n)$ processes are calculated by perturbation methods for energies up to a few MeV. Agreement with expt. is fairly good except for the $(n, 2n)$ process, for which calculated values are much too low. A. P. F.

539.172.4

4156. Disintegration of nitrogen by fast neutrons. Sikkema, C. P. Letter in *Nature, Lond.*, **162**, 698–9 (*Oct.* 30, 1948).—A N-filled proportional counter was placed at various directions with respect to a D + D neutron source (thin target, 0·4 MeV bombarding energy). The yield of (n, α) and (n, p) reactions in N was thus studied over the range 2·1–3·2 MeV neutron energy. A curve of $(\sigma_{np} + \sigma_{n\alpha})$

v. energy is given, showing a well-defined resonance at 2·23 MeV. A. P. F.

539.172.4

4157. The excitation functions of some (np) reactions. BRETSCHER, E. AND WILKINSON, D. H. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 141–4 (1949).—The activation method was used for studying the reactions, the fast neutron source used being the D + D reaction, ${}_1H^2 + {}_1H^2 = {}_2He^3 + {}_0n^1$. Excitation functions were obtained for these 4 reactions: $Al^{27}(n, p)Mg^{27}$, $P^{31}(n, p)Si^{31}$, $Cu^{65}(n, p)Ni^{65}$, and $Zn^{64}(n, p)Cu^{64}$. L. S. G.

539.172.4

4158. Future developments in nuclear energy. GOODMAN, C. *Nucleonics*, **4** (*No.* 2) 2–16 (*Feb.*, 1949).—Possible basic designs for aircraft with nuclear power units are described. The feasibility of driving a submarine with a reactor is discussed in some detail. A survey of world power problems leads to the conclusion that use of nuclear fuels would probably not give cheaper power in the U.S.A., but might do so in certain other countries. A. P. F.

539.172.4

4159. Preparation of pure iron-59 of high specific activity. KENNY, A. W. AND MATON, W. R. E. Letter in *Nature, Lond.*, **162**, 567–8 (*Oct.* 9, 1948).—Fe was extracted with dilute ethereal HCl from hydroferrocyanic acid after prolonged irradiation in a pile (1 month at a slow neutron flux of $2{\cdot}5 \times 10^{10}$). About 300 μg Fe, of specific activity $\sim 1{\cdot}5$ mc/g, was obtained per g of hydroferrocyanic acid. The extraction process removed the same weight of Fe from a non-irradiated sample. A. P. F.

539.172.4 : 537.542

Measuring the energies of fission fragments. *See Abstr.* 4053

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

4160. A tentative semi-classical theory of multiple processes. CLEMENTEL, E. AND DALLAPORTA, N. *Nuovo Cim.*, **5**, 235–48 (*Aug.*, 1948) *In Italian.*—The Heitler theory for the creation of mesons in p–p collisions gives a very high value for the cross-section. The probability of emission of a meson is > 1, and this probability is interpreted as the mean number of mesons emitted in a single collision. A simple formalism is given for calculating the cross-section for a process of any multiplicity. The energy distribution of the mesons emitted is discussed and the relative order of magnitude of the new type of multiple process is compared with that of an ordinary high order process. The cross-sections for the first orders of multiplicity are calculated numerically, using the M–R theory. They are $\ll$ the Heitler cross-sections and are of the right order of magnitude. L. S. G.

539.18

4161. Magnetic deflector for mesons produced in the 184-inch cyclotron. PANOFSKY, W. K. H. AND MARTINELLI, E. A. *Rev. Sci. Instrum.*, **20**, 286–8 (*April*, 1949).—A magnetic deflector has been constructed which makes the mesons artificially produced in the 184 in cyclotron by α-particle bombardment available outside the cyclotron tank. The deflector consists of a magnetic shield especially designed to operate in very high external magnetic fields. The effect of the magnetic shield on the internal cyclotron beam has been compensated by pole shims. The deflector yields a total meson flux of approximately 500 mesons per minute. A.

539.18 : 530.145

The perturbation method in the theory of quantised fields. *See Abstr.* 3765

539.18 : 530.145

On the wave equation of a particle of maximum total spin ($h/2\pi$) possessing several mass states. *See Abstr.* 3766

539.18 : 530.145

On some properties of particles of spin ½ in electromagnetic fields. *See Abstr.* 3767

539.18 : 537.591.8

4162. On the absorption of meson-producing nucleons. HEITLER, W. AND JÁNOSSY, L. *Proc. Phys. Soc., Lond. A*, **62**, 374–85 (*June*, 1949).—The absorption of nucleons passing through any number of nuclei is calculated with due consideration of all fluctuations of energy loss. For the probability $w(\varepsilon, E)d\varepsilon$ for an energy loss ε by a nucleon with energy E hitting a nucleon at rest, a law of the form $wd\varepsilon = w(\varepsilon/E)d\varepsilon/E$ is assumed, a law suggested by meson theory and Bremsstrahlung. It is shown that, with a primary spectrum, following a power law, the absorption is strictly exponential for any thickness of the absorber and for all energies of the nucleons, apart from small deviations at low energies due to the latitude cut-off. This agrees well with recent experimental results. The experiments also permit some conclusions about the shape of the function w, and it is shown that w must be a fairly broad distribution extending up to $\varepsilon/E = 1$, possibly favouring, but not to a very large extent, low values of ε/E. The average energy loss of a fast nucleon hitting a nucleon at rest is determined by the experiments within very narrow limits. The conclusions that can be drawn about w, the total cross-section for meson production and the average energy loss are all compatible with the theory of Hamilton, Heitler and Peng, in its later version. A.

539.18 : 537.591.8

Differential spectrum of low energy mesons. *See Abstr.* 4076

539.18 : 539.152.1

4163. On the absorption of heavy mesons by the deuteron. MARTY, C. AND PRENTKI, J. *C.R. Acad. Sci., Paris*, **227**, 765–7 (*Oct.* 18, 1948) *In French.*—The disintegration of a deuteron by π-mesons is calculated using a Moller–Rosenfeld mixture. The cross-section for π^+ mesons is negligible when Coulomb repulsions are included, and $\pi - \mu$ decay is more probable. It is $\sim 10^{-28}$ cm^2 for π^- at low energies, but there is then competition with capture into the K-shell. For the neutral mesons, if they are sufficiently stable the disintegrations would in principle establish its existence, as the angular distribution of the protons emitted is different from those emitted in an n–d process. G. J. K.

539.18 : 550.36

4164. Thermal consequences of the capture of neutrinos by the earth. BENFIELD, A. E. Letter in *Phys. Rev.*, **74**, 621 (*Sept.* 1); *errata*, 1192 (*Nov.* 1, 1948).—The heating of the earth by neutrinos emitted from the sun is discussed. It is pointed out that a recent estimate [Abstr. 2188 (1948)] of an upper limit for the capture cross-section of neutrinos by matter, based on measurements of the outward flow of heat at the earth's surface, is not entirely valid, as temp. equilibrium would not have been established within the earth's lifetime. The upper limit might have to be increased by a factor of ~ 10. A. P. F.

539.181 : 539.132

4165. On the ammonia molecule. MIZUSHIMA, M. Letter in *Phys. Rev.*, **74**, 705–6 (*Sept.* 15, 1948).—Second-order perturbation theory is applied to the calculation of the intensity changes in an NH_3 molecular beam deflected by an inhomogeneous electric field, and also to that of the $\frac{1}{2}$-width of the inversion absorption line $J = 3$, $K = 3$. The results are in fair agreement with experimental data. L. P.

539.185

4166. Delayed neutrons. DAS, S. Letter in *Nature, Lond.*, **162**, 853 (*Nov.* 27, 1948).—In view of the basic equivalence between photo- and electro-disintegration, it is suggested that delayed neutron emission in fission products may be due to ejection of neutrons by β-rays (photo-disintegration being ruled out because fission γ-rays have not enough energy). Application of this theory to the known delayed neutron emission which follows 195 MeV d bombardment of O then suggests that N^{16} and not O^{17} is the n-emitting nucleus. A. P. F.

539.185

4167. The scattering of high-energy neutrons by protons and the law of interaction between nucleons. BURHOP, E. H. S. AND YADAV, H. N. *Proc. Roy. Soc. A*, **197**, 505–23 (*July* 7, 1949).—Calculations have been carried out of the angular distribution and total collision cross-section to be expected in the case of the scattering of neutrons of energy in the range 83 to 250 MeV by protons. Born's approximation has been used in these calculations, and a large variety of possible shapes and ranges for the radial variation of the interaction potential has been investigated. For each case the radial variation of the central and non-central parts of the interaction was taken to be the same. The conditions for the validity of this approximation are discussed. Although only fair at the lower end of the energy range studied it should give reasonable results at the upper end of the range, especially in the case of potentials other than the spherical well. The exchange properties of the interaction should be capable of deduction from the general shape of the angular distribution of the scattering curves. It is more difficult to obtain evidence about the exact form of the radial variation of the interaction potential from the angular distribution curves because, for any given potential shape, a wide variety of different predicted angular distributions are obtained by varying the range of the interaction. Potentials of the exponential and Yukawa type, however, show a greater concentration of the scattering into angles near 0 and 180° than is the case for a spherical well interaction. The total collision cross-section depends quite markedly both on the exchange properties and radial variation of the interaction. Closest agreement with the measurements of total cross-section for 90 MeV neutrons are given for a symmetrical interaction with a radial variation in the form of a Yukawa potential of range $1{\cdot}18 \times 10^{-13}$ cm, although this interaction predicts too large a value for the ratio of the differential cross-section at 180° to that at 90°. A.

539.185 : 538.249 : 536.48

4168. Non-elastic scattering of slow neutrons in ferromagnetics at low temperatures. AVAKIANTS, G. *J. Exp. Theor. Phys., USSR*, **18**, 444–8 (*May*, 1948) *In Russian.*—The non-elastic collisions considered are of the type produced by excitation and absorption of spin waves by the neutrons. A.

539.185 : 548.7 : 538.221/.2

4169. Neutron refraction. AKHIESER, A. AND POMERANCHUK, I. *J. Exp. Theor. Phys., USSR*, **18**, 475–8 (*May*, 1948) *In Russian.*—Formulae are given for the refractive index of slow neutrons for ordinary crystals and magnetized substances (ferro- and para-magnetics). In the latter case the refractive index as well as the angle of total reflection depends on the orientation of the neutron spin relative to the magnetic induction vector. The latter fact may be used for obtaining a fully polarized beam of neutrons. A.

STRUCTURE OF SOLIDS 539.2

539.214

4170. Theory of plasticity—elements of simple theory. RODERICK, J. W. *Phil. Mag.*, **39**, 529–39 (*July*, 1948).—The transition of mild steel from the elastic to the plastic state is discussed and a theory of simple bending is outlined. Bending combined with axial loading is also examined. Experiment shows that the theory is accurate in the case of pure bending; but more experimental work is needed on the influence of shearing force on the plastic condition before the theory can be tested. L. S. G.

539.215 : 539.4.016

4171. Recovery and recrystallization as processes of dissolution and movement of dislocations. BURGERS, W. G. *Rep. Conf.* "*Strength of Solids*" (1947) *Phys. Soc., Lond.*, 134–7 (1948).—A note on the author's work [Abstr. 2658 (1947)], in particular, its relation to the work of Cook and Richards [*J. Inst. Met.*, **73** (1946)], on the subject of the softening of cold-rolled copper and the processes of recovery and recrystallization. A. J. K.

539.215.2

4172. The analysis of grain size by sedimentation with application to powder metallurgy. NGUYEN, T. C. *Ann. Radioélectricité*, **3**, 115–23 (*April*, 1948) *In French.*—The methods used are the pipette and the rate of deposition measured by a balance. In the first method the Andreasen pipette has been modified and in the second an automatically registering balance is employed. Experimental precautions are discussed. A. H. W. B.

539.23

4173. The mechanism of the formation of films on metals. EVANS, U. R. *Proc. Pittsburgh Internat. Conf. Surface Reactions*, 71–6 (1948). *Corrosion Mater. Protect.*, **5**, 15–19 (1948).—There are 4 laws governing the formation of films on metallic surfaces which are considered by Vernon to be satisfactorily established experimentally—the parabolic, the rectilinear, the logarithmic and the asymptotic. A picture of the mechanism of film growth which leads to these laws is presented. It is considered that (for oxide films) O passes into the metal, forming a solid solution, and nuclei appear after supersaturation is reached. Oxide spreads laterally over the surface from these nuclei; this oxide and that subsequently formed is laterally compressed and cannot take up an unconstrained structure. Thickening of the films is considered to take place according to Wagner's mechanism, by the outward movement of cations and electrons, explaining why films having poor electronic or ionic conductivity are protective. As growth proceeds breakdown of the film will periodically occur, the mode of breakdown determining the growth law. Thus at high temp. there will be a tendency for plastic flow to relieve stress without cracks necessarily being formed. At lower temp., cracking may occur, resulting in a film composed of an outer shattered layer over an inner compact layer, and according to the properties of these 2 layers, the growth may proceed by either the parabolic or the rectilinear law. At still lower temp., blistering may occur, and the cracks parallel to the surface so produced lead to the logarithmic and asymptotic laws replacing the rectilinear and parabolic. The picture developed thus leads to the laws experimentally obtained without the necessity of making any *ad hoc* assumptions. M. A.

539.23

4174. The growth and structure of thin metallic films. LEVINSTEIN, H. *J. Appl. Phys.*, **20**, 306–15 (*April*, 1949).—The structure of thin metallic films was studied by means of electron diffraction and electron microscopy. Microcrystal size can be correlated with the melting point of the metals, those with high melting points producing continuous films of small unoriented microcrystals while those with low m.p. produce large microcrystals oriented preferentially with respect to the substrate. The effects of varying experimental conditions on the film structure of selected metals are reported. The electron beam of the electron microscope affects metals with low m.p. most directly, producing melting, sublimation or crystallization. Variations in the velocity of the impinging atom, obtained by passing thermal atoms through a mechanical velocity selector, produce no effect for metals whose vapour is monatomic. Sb, whose vapour is found to consist of polyatomic molecules as well as atoms, produces films whose grain size seems to vary with the size of the molecules forming the Sb film. The rate of evaporation merely determines whether Zn or Cd films may or may not be formed while for Sb films it also determines the type of the films formed. Those formed by rapid evaporation consist of small crystallites while those formed by slow evaporation consist of large amorphous patches. This effect is explained on basis of the mobility of the atoms on the substrate, the mobility time being determined to be $< 2\times10^{-5}$ sec. The mobility time and therefore the structure depends upon the type of substrate. The degree of vacuum is critical when the residual vapour reacts with the film being formed, but if no reaction takes place between residual vapour and film, pronounced variation for films formed in a vacuum are produced only when the pressure is $> 10^{-2}$ mm of Hg. A

539.232

4175. On the structure of silver sulphide and silver-arsenic alloy grown on silver crystals. MIWA, M AND WATANABE, Y. *J. Phys. Soc. Japan*, **3**, 52–6 (*Jan.–Feb.*, 1948).—The structure of acanthite formed by H_2S on a single crystal film of Ag differs in orientation when the film is deposited on molybdenite or rock salt. Crystallographic relations are discussed as well as the phenomena arising from the presence of arsine in the H_2S. A. J. K

539.234 : 537.533.7

4176. Electron diffraction investigation of silicon and its oxides. KÖNIG, H. *Optik*, **3**, 419–29 (*July–Aug.* 1948) *In German.*—By evaporating Si under certain conditions, thin films are obtained which yield an electron diffraction pattern consisting of a broad ring corresponding to $d = 3\cdot6$ Å, which is attributed to SiO. SiO evaporated *in vacuo* gives the same pattern. The formation of SiO can be avoided by evaporating Si from C crucibles and sweeping with H. The SiO film changes to SiO_2 on heating, giving a diffraction pattern identical with that of fused silica thinned in HF. The crystal size for fused silica is estimated from ½-width measurements to be 10–15 Å. There is no change in ½-width after prolonged heating at 900°C although on heating at 1 000°C the material crystallizes out to α-cristobalite or α-quartz. The results confirm the network hypothesis of Zachariasen and contradict the crystallite theory. The use of silicon oxide films in electron diffraction and electron microscopy is discussed. M. R. H

539.26 : 539.4.0

4177. Strength of metals. WOOD, W. A. AND RACHINGER, W. A. Letter in *Nature, Lond.*, **162**, 891–2 (*Dec.* 4, 1948).—Experiments with X-rays of 0·5–0·7 Å on certain body-centred cubic metals which had been heavily deformed enabled the broadening of X-ray back-reflection lines due to (*a*) the small crystallites within the grains, and (*b*) internal strains, to be distinguished. The crystallite size thus measured, Bragg's expression for the critical stress is used to obtain values for the tensile strengths. Results are compared with experiment and shown to be of the right order. A. J. K

539.26/.27

4178. X-ray, electron and neutron diffraction. SHULL, C. G. AND WOLLAN, E. O. *Science*, **108**, 69–75 (*July* 23, 1948).—A comparative study of the application of these techniques to structure analysis. A. P. I

539.26

4179. Small angle X-ray scattering of various cellulose fibers. HEYN, A. N. J. *J. Amer. Chem. Soc.* **70**, 3138–9 (*Sept.*, 1948).—Values for small angle

X-ray scattering of various cellulose fibres differ considerably from each other and, following Kratky, these angles are related to the min. size and intermicellar distance of the micelles. Approx. values are computed for the average period and deductions are made regarding the size of the different micelles. Micellar orientation may be deduced from the scattering photographs. W. R. A.

539.27

4180. Morphological changes of tactoid-forming particles. Watson, J. H. L., Heller, W. and Wojtowicz, W. *J. Chem. Phys.*, **16**, 997–8 (*Oct.*, 1948).—Electron micrographs of tungstic acid particles are reproduced and discussed. R. F. B.

539.27

4181. Isothermal and non-isothermal transformations of tactoid-forming particles of tungstic acid. Heller, W., Wojtowicz, W. and Watson, J. H. L. *J. Chem. Phys.*, **16**, 998–9 (*Oct.*, 1948).—Electron micrograph observations on tactoid-forming particles of tungstic acid show that in the isothermal habitus change $A \rightarrow B \rightarrow C \rightarrow D$ the particles of type D develop directly from those of type A by a morphological change of the latter. The *p*H of the suspension increases with increasing age, in part due to change in the particles themselves. A is probably tungstic acid and D is WO_3. Under electron bombardment particles of A change into a fibrillar structure; this is probably due to a heating effect, which results in the non-isothermal transformation of tungstic acid to WO_3. S. J. G.

539.27

4182. Direct electron microscopic thickness determinations of ultramicroscopically thin crystals. Watson, J. H. L., Heller, W. and Wojtowicz, W. *J. Chem. Phys.*, **16**, 999–1000 (*Oct.*, 1948).—A procedure is described for measuring the thickness of platelets formed from a solution of tungstic acid. Intense electron bombardment of the supporting film (Formvar) near the platelet selected for measurement generally results in the film rupturing in a direction parallel to the major axis of the platelet. If the platelet adheres to the film, the net result is a rotation of the platelet about its major axis, from which its thickness may be determined. For a particular specimen, the observed dimensions were $14 \cdot 6\ \mu$ long, $5 \cdot 0\ \mu$ wide and $0 \cdot 35\ \mu$ thick. In certain cases, the method may be used to compare the rigidity of colloidally thin crystals. H. J. H. S.

539.27

4183. New method of sectioning synthetic fibres with the ultramicrotome for examination with the electron microscope. Earle, M. D. and Minkin, J. A. *Text. Res. J.*, **19**, 36–41 (*Jan.*, 1949).—One end of each of the single filaments from 10- or 20-filament rayon or nylon yarn are together embedded with paraffin wax in the tapered tip of a vertical glass tube ($\frac{1}{8}$ in bore), the other ends being held by wax radially around the circumference of a Cu ring of tent-shape form. They are then coated from above with a thin film of Au, by evaporation in a vacuum, and then allowed to fall parallel to one another again. They are then embedded in a thin layer of low-m.p. paraffin wax, held in wax in drinking straws so that the ends project, frozen in liquid nitrogen, and sectioned in a high-speed ultramicrotome, having a rotor speed of 25 000 r.p.m. and a feeding rate of 1 mm/min. The sections are collected on a microscope slide thinly coated with purified polyvinyl formal (deposited from a 0·3% solution in ethylene trichloride), stripped on to a water surface, and dried for 5 min in infrared rays. The electron photomicrographs reproduced (10 500× and 13 000×) demonstrate how the boundaries of the fibres are rendered visible by the Au film. J. G.

539.27 : 548.736.1

4184. Experiments on the lattice building elements of solid bodies. König, H. *Optik*, **3** (*No.* 3) 201–20 (1948) *In German.*—From reasoning based on electron diffraction investigations of thin evaporated layers the conclusion is drawn that the smallest particles in the case of Fe and Cr are body-centred cubic elementary cells. For Ge and Si they are tetrahedra containing 5 atoms, whereas for face-centred cubic substances they are probably cubo-octahedra (having 6 faces square and 8 equilateral triangles) containing 13 atoms. A polished layer is regarded as being made up of small particles of the kind considered. M. R. H.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.31

4185. On the determination of the equilibrium states of a plane elastic medium, admitting free boundaries with constant tensions. Arf, C. *Rev. Fac. Sci. Univ. Istanbul* (*A*) **12**, 309–44 (1947) *In French.*—The components of the stress tensor are given in terms of certain functions; these functions are determined in the case of plane simply connected domains satisfying certain conditions. M. R.

539.311

4186. The semi-infinite solid with variable modulus of elasticity. Hruban, K. *Bull. Int. Acad. Tcheque Sci.*, **46**, 151–66 (1945) *In English.*—The Boussinesq solution of the stress distribution in earth assumes that the modulus of elasticity is constant, whereas it is known that it increases with depth. In this paper, the conditions which must be satisfied if a simple radial state of stress is to be produced are given and some special cases are studied in which the modulus of elasticity is a function of the co-ordinates. H. J. H. S.

539.313

4187. Theoretical formula for the coefficients of restitution of imperfectly elastic bodies. Horak, Z. *Bull. École Polyt. Jassy*, **3**, 218–25 (*Jan.–June*, 1948) *In French.*—In 1834, Hodgkinson gave a formula for the coefficient of restitution k_{12} for a collision between two spheres of elastic moduli E_1 and E_2, viz. $k_{12} = (E_2 k_{11} + E_1 k_{22})/(E_1 + E_2)$, for which there appears to be no theoretical foundation. Using Hertz's theory of the contact of two elastic bodies or the Boussinesq potential theory concerning the deformations of semi-infinite elastic solids, a formula can be derived which is analogous and gives results in close agreement with that of Hodgkinson. H. J. H. S.

539.319

4188. A variational principle for plastic materials with strain-hardening. HODGE, P. AND PRAGER, W. *J. Math. Phys.*, **27**, 1–10 (*April*, 1948).—Only stress states which may be reached from the natural state by a single loading followed by at most one unloading are considered. It is shown that the volume integral of a certain invariant is less for the actual stress rates than it is for any system of artificial stress rates near the actual rates. L. S. G.

539.319 : 536.413

4189. The stresses in bimetals. EICHLEHNER, N. *Elektrotech. u. Maschinenb.* [*EuM*] **65**, 113–16 (*July–Aug.*, 1948) *In German.*—Stresses and strains in a bimetallic strip are calculated under the assumptions that the strip is sufficiently narrow that bending in the cross direction may be neglected, that the 2 strips of different material are connected so well with each other that no separation is possible, and—though not stated explicitly—that the thermal expansion of the material having the smaller expansion coefficient may be neglected. The bending moment, the line of deflection and the energy are calculated. The specific deflection may be determined by the constants of the materials alone. Diagrams are given showing the influence of additional external bending moments. R. N.

539.32

4190. An experimental investigation by a dynamical method of the variation of Young's modulus with temperature. BENNETT, G. E. AND DAVIES, R. M. *J. Inst. Met.*, **16**, 759–76 (*May*, 1949).—Describes a method in which the specimen, in the form of a fixed–free bar about 2·5 cm long, is maintained in transverse vibration by the action of superposed steady and alternating magnetic fields. Resonance of the bar is detected by transmitting its vibration to a gramophone pick-up whose output is amplified, rectified, and applied to a galvanometer. The ratio of Young's modulus at any 2 temps. is shown $\simeq$ the square of the ratio of the 2 corresponding natural frequencies of the bar in the fundamental mode and in zero magnetic field. A small correction factor for the thermal expansion of the material is discussed. Young's modulus–temp. curves are reproduced for commercial brass, Cu, mild steel, Fe, Ni, Co, Monel metal, Ferry, iron–48% nickel alloy, β brass, and Cu–Au alloy. The discontinuities in these curves are discussed and the results compared with those of previous investigators. The accuracy of the results is considered, and the advantages of the method over existing methods indicated. A.

539.32 : 548.0

4191. Elastic constants of garnets. RAO, B. R. *Proc. Indian Acad. Sci. A*, **22**, 194–8 (*Sept.*, 1945).

539.374

4192. Anisotropic plastic flow. FISHER, J. C. *Trans. Amer. Soc. Mech. Engrs*, **71**, 349–56 (*May*, 1949).—The mathematical theory of plasticity has been generalized to apply to plastically anisotropic materials. The anisotropic flow theory has been shown to reduce to the resolved shear-stress/shear-strain relationship for single crystals, and to the distortion energy theory for isotropic polycrystals. Experimental data concerning the plastic flow of anisotropic polycrystalline Al indicate that the predictions of the anisotropic flow theory are in good agreement with experiment, and are significantly better than the predictions of the distortion energy theory. As plastic anisotropy is the rule rather than the exception, caution is indicated in interpreting the results of combined stress tests by means of the distortion energy theory. A.

539.374 : 541.64

4193. A theory of viscous deformation in polymers; the volume and surface cohesional energy of the basic moving aggregate. MOREY, P. R. *J. Phys. Coll. Chem.*, **53**, 569–89 (*April*, 1949).—An analysis of viscous flow based on the dynamics of particle bonding and movement leads to the following expression for the viscosity:

$$\eta = \frac{B}{V^{0,2/3}T^{2,3}} e^{V^{2/3}(4.8\times10^{24}Z - 1.9\times10^{8}S)/RT}$$

The choice of exponents depends on the range of internal force fields. T is temp.; V is the average volume in cm³ of the material which flows as a unit in deformation; Z is a surface-energy factor measuring the intensity of secondary bond development per cm² of surface of the flow unit; and S is the applied tensile stress in dynes/cm². In addition to this basic form, it is necessary, in order to characterize viscosity completely, to recognize the existence of the functions $V = f(T, S)$, $Z = G(T, S)$. The non-Newtonian character of viscosity is accounted for, and is intimately connected with the size of the flow unit. For polyvinyl acetate film, it is shown that V decreases with increasing temp. but that Z may, under certain non-plasticized conditions, actually be increased by a temp. rise. This accounts for the interesting behaviour observed on dry polyvinyl acetate where the activation energy of flow increases rather than decreases with increasing temp. A device is illustrated which automatically keeps the stress constant over deformations up to 50%. From the curves of viscosity v. stress, values are calculated for the volume of the flow unit for dry polyvinyl acetate, using the formula:

$$V^{2/3} = \frac{2\cdot3RT\log\eta_1/\eta_2}{1\cdot9\times10^{8}(S_2 - S_1)}$$

where S is the tensile stress in dynes. A.

539.374 : 548.0

Residual lattice strains in deformed polycrystalline metal aggregates. *See Abstr.* 4255

539.389

4194. The determination of static and dynamic yield stresses using a steel ball. DAVIES, R. M. *Proc. Roy. Soc A*, **197**, 416–32 (*June* 22, 1949).

539.4.01 : 539.26

Strength of metals. *See Abstr.* 4177

539.4.012

4195. The spread of pressure in a half disc in which the elastic modulus decreases with depth. BOROWICKA, H. *Öst. Ingen.-Arch.*, **2** (*No.* 5) 360–3 (1948) *In German.*—A mathematical paper dealing with the cases of point and distributed loads. Reference is made to a similar problem by Wolf [Abstr. 4833 (1935)]. L. G. C.

539.4.014.13

4196. The theory of stresses in two-component glass to metal tube seals. RAWSON, H. *J. Sci. Instrum. Phys. Ind.*, **26**, 25–6 (*Jan.*, 1949).—A theory is given based on the Lamé theory for stresses in thick cylinders which gives the relationship between the tangential, radial and axial stresses, at a point in a two-component tube seal and the distance of that point from the central axis of the seal. Curves are given which show the relationships between the values of the principal stresses at the seal interface and the dimensions of the seal. A.

539.4.014.13 : 535.55

4197. The determination of the separate stresses in three-dimensional stress investigations by the frozen stress method. JESSOP, H. T. *J. Sci. Instrum. Phys. Ind.*, **26**, 27–31 (*Jan.*, 1949).—Of the methods of separating the principal stresses used in the 2-dimensional problem the only one available in the case of a 3-dimensional stress distribution is that of a step-by-step integration along a line of principal stress. This method, moreover, is possible only when the chosen line of principal stress can be plotted and the magnitudes of the principal stress differences determined at a series of points on the line. These two considerations limit the application of the method in practice to lines of principal stress lying in a plane of symmetry, and in such cases an extension of the Lamé–Maxwell equations to 3 dimensions can be used in conjunction with "frozen stress" observations. A.

539.4.015.1 : 669

4198. Size effects in steels and other metals. SHEARIN, P. E., RUARK, A. E. AND TRIMBLE, R. M. *Rep. Conf. "Strength of Solids"* (1947) *Phys. Soc., Lond.*, 158–62 (1948).—Discusses the dependence of mechanical properties on size in geometrically similar and homogeneous specimens, with reference to experiments on Ni–Cr steels. The influence of flaws and the much larger size effect occurring in "bend" testing than that in tensile tests are each considered. A. J. K.

539.4.016.2

4199. The strength of metals. BRAGG, L. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 125–30 (1949).—An expression is derived for the yield-stress of a cold-worked metal, in terms of its structure and elastic constants. Plastic flow in metals is discussed and the treatment given is a modification of that of G. I. Taylor [Abstr. 3119 (1934)]. The calculations of the ultimate shear strength show that the formula gives estimates of the strength of the right order of magnitude. L. S. G.

539.4.016.2

4200. The change in strain energy caused by a dislocation. DEAN, W. R. AND MANN, E. H. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 131–40 (1949).—Two systems of 2-dimensional strain in a homogeneous elastic medium, bounded internally by 2 long circular cylinders, are considered. The first is in a state of simple shear and the stress-function and displacements are calculated. In the second the strain arises from a dislocation in which a relative displacement in the direction joining the cylinders is imposed on a certain pair of planes. The stress-function and displacement are obtained and compared with those of the first system. For applications of the results of this paper to Bragg's theory of yield in metal crystals see Abstr. 4199. L. S. G.

539.42

4201. Note on "Statistical aspects of fracture problems." FOWLER, F. H., JR. Letter in *J. Appl. Phys.*, **19**, 1092 (*Nov.*, 1948).—Mentions 3 points which are relevant to the subject [Abstr. 1341 (1948)]: (i) Strengths of specimens should follow a probability distribution with finite limits. (ii) Strength determined by the strongest strand can determine the extreme values. (iii) Percentiles rather than modes or expected strengths are preferable for design purposes. G. O. B.

539.55

4202. Cleavage patterns disclose "toughness" of metals. ZAPFFE, C. A., WORDEN, C. O. AND LANDGRAF, F. K. *Science*, **108**, 440–1 (*Oct.* 22, 1948).—"Toughness" is identified with structural stability if a material is stressed non-axially, as by bending or lateral impact. It is claimed that examination at high magnification of the cleavage facets of individual grains in structural steels shows marked relationship with toughness, as determined by mechanical testing and by actual service. Illustrative photomicrographs are given. L. G. C.

539.67 : 534.37

4203. Dislocations as a cause of mechanical damping in metals. ESHELBY, J. D. *Proc. Roy. Soc. A*, **197**, 396–416 (*June* 22, 1949).—Zener [Abstr. 619 (1940)] has shown how thermoelastic effects give rise to damping of the mechanical vibrations of a solid. In a vibrating single crystal of a metal an additional energy loss is observed which is usually attributed to the motion of dislocations. In the present paper the following mechanism is proposed. Dislocations are trapped in "potential troughs" at the minima of the internal stress in the crystal. When the crystal vibrates the dislocations oscillate in their potential troughs and the moving stress-system associated with them produces a fluctuating temp. distribution in the material; this leads to damping as in Zener's case. The rate of loss of energy produced by a dislocation oscillating with given amplitude is calculated and the effect of a collection of them is discussed. An actual estimate of the damping in a vibrating crystal requires (i) a knowledge of the relation between the amplitude of oscillation of a dislocation and the vibrational stress causing it to move, and (ii) a knowledge of the density of dislocations in the material. A tentative discussion of (i) is given. The quantity (ii) is unknown; however, it is shown that the damping depends only on the ratio of the number of dislocations per unit area to the number of potential troughs per unit area. If this ratio is calculated from the theoretical result and the observed damping in Cu single crystals, it is found to be ~ 1. The present theory predicts that the damping should increase with frequency. This is in disagreement with the limited experimental data available. Two subsidiary effects are also investigated, the thermoelastic damping arising from

the interaction between the vibrational stresses and the stresses surrounding stationary dislocations, and the damping due to the emission of elastic waves from an oscillating dislocation. Both these effects are shown to be small compared with the thermoelastic damping caused by moving dislocations. A.

PHYSICAL CHEMISTRY 541

THERMOCHEMISTRY 541.11

541.11

4204. Optical determination of the heat of dissociation for certain substances in the solid state. ATANASIU, G. *Bull. Soc. Roumaine Phys.*, **47** (*No.* 84) 7–23 (1946) *In French.*—Heats of dissociation, Q, are deduced from measurements of absorption bands of solid halides of Hg, Tl, Li, Na, K, Rb and Cs. They can be expressed in terms of 2 optical frequencies, ν_1 characterizing the halide and ν' the halogen, by the equation $Q = Nh(\nu_1 - \nu')/J$. Deviation from values derived calorimetrically is generally $< 2\%$. AgCl, AgBr, HgCl and TlI are exceptions. C. B. A.

541.115

4205. The energy of dissociation of the molecule CO and the role of excited atoms and radicals from the point of view of chemical bonds. VALATIN, J. G. *Rev. Sci., Paris*, **86**, 135–40 (*Feb.* 1, 1948) *In French.*—Proposed values for the dissociation energy of CO are reviewed, and Schmid and Gerö's value of 6·92 eV is defended. The application of the non-crossing rule is criticized. In ketones and aldehydes the CO group resembles the $a^3\Pi$ state of CO rather than the ground state; the CH group in organic chemistry corresponds to the $^4\Sigma$ state of the radical. In considering chemical bonds one must take into account the excitation of the atoms and radicals involved. A. G. G.

541.115

4206. Heats of combustion. IV. The heats of combustion of five aromatic amines. SULLIVAN, M. V. AND HUNT, H. *J. Phys. Coll. Chem.*, **53**, 497–500 (*April*, 1949).

PHASE EQUILIBRIUM 541.121/.123

541.123.3

4207. An analysis of reactions in three-phase-state spaces in three-component systems. SHURTZ, R. F. *J. Phys. Coll. Chem.*, **53**, 519–26 (*April*, 1949).

REACTION KINETICS 541.124/.128

541.124 : 533.59

4208. Reactions of metals in high vacua. GULBRANSEN, E. A. AND ANDREW, K. *Proc. Pittsburgh Internat. Conf. Surface Reactions*, 222–36 (1948).—Chemical reactions occurring in a high vacuum at high temp. are grouped into three classes: (i) those in which gases are produced, (ii) those in which gases are removed, and (iii) those in which one gas is removed and another produced. Reactions considered under (i) and (ii) are the O equilibrium over oxide and metal, the formation or removal of CO or CO_2 by reaction of surface oxides with C in the metal, and the vaporization of the metal. Under (iii) the reactions considered are the reduction of water to form oxide and H, the reduction of CO_2 to form oxide and CO, and the reaction of H with C in the metal to form methane. Apparatus is described for studying these reactions at temp. up to 1 200°C and pressures $\leqslant 10^{-5}$ mm Hg. Results are given for the following reactions: the vacuum oxidation of Zr, W, Mo and stainless steel; the formation of CO in the case of stainless steel; the volatilization of molybdenum trioxide; and the oxidation and evaporation of Mg. M. A.

541.124 : 548.52

Single crystals for the study of surface reactions. *See Abstr.* 4259

541.126

4209. The susceptibility of nitroglycerine to explosion by impact in the presence of various gases. MULCAHY, M. F. R. *Phil. Mag.*, **39**, 547–60 (*July*, 1948).—The effect of decreasing initial pressure on the sensitizing action of gas entrapped in nitroglycerine under conditions of cavity impact [Abstr. 1336 (1947)] was investigated for air, N, O, H and He. In all cases the gas becomes less effective in causing initiation of explosion as the initial pressure decreases. The relative sensitizing effects of the gases were found to be in the order $He \simeq N > H$ and $O > N > H$. The impact apparatus used is briefly described. L. S. G.

541.126

4210. Initiation of explosions by grit particles. BOWDEN, F. P. AND GURTON, O. A. *Nature, Lond.*, **162**, 654–5 (*Oct.* 23, 1948).—Experiments on ignition by friction and impact of P.E.T.N. containing small solid particles of varying melting point showed that particles with m.p. > 430°C were effective in initiating explosions and those with m.p. < 400°C ineffective. Similar results were obtained with other explosives. T. S. E. T.

541.126

4211. Explosion waves and shock waves. VII. The velocity of detonation in cast T.N.T. CYBULSKI, W. B., PAYMAN, W. AND WOODHEAD, D. W. *Proc. Roy. Soc. A*, **197**, 51–72 (*April* 22, 1949).—The Buxton rotating-mirror camera has been used for the precise determination of velocities of detonation in cylinders of cast T.N.T. The effects of the following variables have been studied: (*a*) the purity and crystal size, (*b*) the diameter, and (*c*) the degree of confinement. Correlation of the observations with those of detonation velocity shows that cast T.N.T. may

undergo stable or unstable detonation according as the crystals are small or large respectively. The unstable regime is characterized by the failure of the detonation wave to be propagated uniformly over the full cross-section of the cylinder of explosive. The velocity of detonation of T.N.T. rises as the diameter of the cylinder is increased from a "boundary diameter," below which there is no propagation, to a "limiting diameter" at which the velocity reaches a maximum value. In castings of density 1·625 the maximum velocity is 6 950 m/sec. The value of the boundary diameter is a measure of the sensitivity to propagation. The effect of heavy confinement is to reduce the boundary and limiting diameters; the maximum velocity, however, remains unaltered and confinement has therefore the same effect as an increase in diameter in an unconfined charge. A.

541.126 : 536.46

4212. The structure of the reaction zone in a flame. BOYS, S. F. AND CORNER, J. *Proc. Roy. Soc. A*, **197**, 90–106 (*April* 22, 1949).—The structure of one-dimensional flames is shown to be completely determined by constants such as those of heat conductivity, of diffusion, and of the homogeneous reaction rates. The mathematical problem in the most general case is intractable, but 3 simple cases are solved fully by a mathematical method of successive approximations. The cases are those in which diffusion is neglected compared with heat conductivity and in which reaction velocities of the following types are considered: unimolecular, bimolecular and the quasi-bimolecular form of a unimolecular reaction at low pressures. The method of mathematical approximation is shown to involve errors of the order of only 10% in some actual cases, an error which is negligible compared with other uncertainties of the problem. In these simple cases it is possible to solve all details of the structure such as the variation of composition and temperature through the flame. A.

541.128 : 539.23 : 537.311.33

4213. The application of semi-conductivity measurements in the study of catalysis on copper oxide. GRAY, T. J. *Proc. Roy. Soc. A*, **197**, 314–20 (*June* 22, 1949).—An apparatus has been constructed to measure the electrical conductivity of thin films of oxides in order to study the effects of adsorbed gases and reactions between them. This has been applied to the cuprous-cupric oxide system. A.

ELECTROCHEMISTRY 541.13

541.13

4214. The electromotive force and thermodynamics of the oxygen concentration cell. KARPEN, V. *C.R. Acad. Sci., Paris*, **227**, 767–8 (*Oct.* 18, 1948) *In French.*—It is shown that the formulae found for the e.m.f. of a concentration cell, whether deduced from the hypothetical theory of Nernst or by thermodynamics, afford a value in the case of the O concentration cell $\sim 0{\cdot}0098$ V. An experiment is described in which the actual e.m.f. is $\sim 0{\cdot}063$ V, i.e. 6·3 times > the theoretical value. H. H. HO.

541.13

4215. Electrochemical behaviour of metals. PIONTELLI, R. *Ric. Sci.*, **18**, 824–30 (*July*, 1948) *In Italian.*—Metals may be classified according to their electrochemical behaviour into "quasi-ideal" or normal (e.g. Pb, Tl, Hg and Cd), and those possessing electrochemical inertia or barrier effect (transition metals having an incomplete electronic substrate, e.g. Cu and Au). These differences are related to the polarization and overvoltage effects observed when the metals are immersed in solutions of their salts; in particular, the anodic and cathodic potential curves show a much sharper transition point with the latter than with the former. The effects of the anions present on the electrochemical inertia are discussed, with special reference to the ions of the halogen series, and an explanation of the causes and stability of passivity in terms of the above theory is proposed. J. G.

541.131

4216. Some fundamental studies of electrolytes and electrochemical couples over the temperature range 25°C to −75°C. GARRETT, A. B., WELSH, J., WOODRUFF, S., COOPER, R. AND HEIKS, J. *J. Phys. Coll. Chem.*, **53**, 505–18 (*April*, 1949).

541.132

4217. Ionic exchange equations derived from statistical thermodynamics. KRISHNAMOORTHY, C., DAVIS, L. E. AND OVERSTREET, R. *Science*, **108**, 439–40 (*Oct.* 22, 1948).—The Fowler and Guggenheim method of discussing the equilibrium adsorptions of mixed gases on surfaces has been applied to ionic exchange "adsorption" states. The final expression (no derivation is presented) is $k_{(A,B)} = [A]^{r_2}/[B]^{r_1} \cdot [q_1A + q_2B + q_3C + \ldots]^{r_1 - r_2} \cdot (B)^{r_1}/(A)^{r_2}$ where A, B, $C \ldots$ are ionic species of valencies r_1, r_2, $r_3 \ldots r_n$, and $q_n = (r_n + 1)/2$; terms in brackets represent numbers of moles of replaceable ions in the adsorbent phase, terms in parentheses represent "ionic activities" in the aqueous phase. The equation as applied to a system containing La, Cs and H has been tested experimentally with clay and synthetic resin. The results for the synthetic resin IR 100 give consistent values for the equilibrium constant. F. L.

541.132

4218. The exchange of Ag^+ ions between aqueous solutions and surfaces of metallic silver. COFFIN, C. C. AND TINGLEY, I. I. Letter in *J. Chem. Phys.*, **17**, 502–3 (*May*, 1949).

541.132.3

4219. Control of *p*H values. LIENEWEG, F. *Arch. tech. Messen* (*Issue No.* 160) *Ref. J*065–1, *T*25–7 (*March*, 1949) *In German.*—The control of *p*H values is discussed with respect to: accuracy, gradation, storage, accuracy from titration curves and titration equations, strong acids with strong bases, stepwise regulation, weak acids and bases, and buffer solutions. Comparison data are given of simple and stepwise control, and of titration equations for the regulation of acids and of acid-salt mixtures. H. H. HO.

541.133.1 : 539.155.2

Shift in abundance of the Cd isotopes by ionic migration in molten $CdCl_2$. *See Abstr.* 4123

PHOTOCHEMISTRY 541.14

541.141 : 578.088.5

4220. Hydrogen peroxide and the indirect effect of ionising radiations. ALPER, T. *Nature, Lond.*, **162**, 615–16 (*Oct.* 16, 1948).—Experiments on the effect of ionizing radiations on bacteriophage S13 suggest that, for this phage at least, the results are due to the intermediate production of H_2O_2. C. B. A.

541.144

4221. The quantum efficiency of the mercury sensitized photochemical decomposition of hydrogen. THOMAS, L. B. AND GWINN, W. D. *J. Amer. Chem. Soc.*, **70**, 2643–8 (*Aug.*, 1948).—The quantum efficiency of the Cario and Franck Hg2537 sensitized decomposition of H_2 has been investigated as a function of Hg and H pressures. The velocity coefficient and effective cross-section are determined for interaction of Hg $^3p_1$ atoms and H bringing about the disappearance of H from the gas phase. The contribution of the re-absorption of fluorescent radiation to the efficiency is considered and the time decay constant of λ2537 from pure Hg vapour in the reaction vessel after excitation has been cut off is calculated. Quenching processes other than that resulting in removal of H are effective and the rate of quenching of Hg $^3p_1$ atoms is several times $>$ rate of removal of H from the gas. W. R. A.

541.144.8

4222. The photochemical degradation of polystyrene. CHEN, S. W. *J. Phys. Coll. Chem.*, **53**, 486–96 (*April*, 1949).—When exposed to ultraviolet light of wavelength 2 537·5 Å, polystyrene molecules are degraded at a rate $\propto$ the first power of the intensity of the incident radiation. The over-all quantum yield is found to be approximately 1/15 500. A.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18

4223. Some physical chemical properties of aqueous solutions of soaps and soapless detergents. HATTIANGDI, G. S., WALTON, W. W. AND HOFFMAN, J. I. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 361–8 (*April*, 1949).—A study has been made of the effect of concentration on the surface tension, electrical conductance, *p*H, opacity and foam formation of aqueous solutions of 30 typical commercial soaps and 6 popular soapless detergents. The results are explained on the basis of the colloidal nature of the solutions and the soap phases that have been found in the solid soaps by studies of X-ray diffraction and electron microscopy. The significance of the results in terms of micelle formation and the relationship between micelles and detergent action are discussed. A.

541.18 : 532.133

4224. Theory of viscosity of colloids: influence of solvent on intrinsic viscosity. PHILIPPOFF, W. *Z. Naturforsch.*, **3b**, 151–9 (*May–June*, 1948) *In German.*—The effect of solvent and of temperature on the value of $[\eta]$ is examined for two models (1) rigid ellipsoids, (2) coiling chains. The first model is unsuccessful, but the observations can be interpreted in terms of the second model, in which the extent of coiling of the long-chain molecules is represented by the number of monomer units per link. R. F. E.

541.18 : 535.3 : 537.53

The dependence of the X-ray small angle scattering on shape and size of colloidal particles in dilute systems. *See Abstr.* 4009

541.182.

4225. A note on the change in average particle mass during the aging of ammonium chloride smokes. LANGSTROTH, G. C., GILLESPIE, T. AND PEARCE, R. M. *Chem. Rev.*, **44**, 337–40 (*April*, 1949).—An analysis of particle number and mass concentration data for the ageing of NH_4Cl smoke in both still and moving air permits certain deductions concerning the average growth of particles under the experimental conditions used. With still air the average mass per particle increased for at least 5·5 hr, although the rate was smaller in the later stages; with rapidly moving air it increased for a comparatively short initial period and then decreased. The results are quantitatively described by equations involving two loss constants and the coagulation constant, whose values were determined experimentally. A.

541.182.

4226. The laws of deposition and the effectiveness of insecticidal aerosols. LA MER, V. K. AND HOCHBERG, S. *Chem. Rev.*, **44**, 341–52 (*April*, 1949).

541.182.

4227. The dispersion and deposition of aerosols. JOHNSTONE, H. F., WINSCHE, W. E. AND SMITH, L. W. *Chem. Rev.*, **44**, 353–71 (*April*, 1949).—The dispersion and deposition of aerosols is considered on the basis of Sutton's theory for the diffusion of gases in the lower atmosphere and Sell's work on the efficiency of deposition of particles by impaction. An estimate is made of the rate of deposition of particles dispersed from a line source under various meteorological conditions. Application of the impaction curves has been made to the penetration and deposition of insecticidal aerosols through a forest canopy. Under conditions of low wind and in the absence of a down draught, the theory predicts that the larger particles will penetrate the canopy better than the small. The opposite is true, however, when the dissemination depends on the down-draught from a plane. Sell's curves may also be used to predict the effect of the drop size of aerosols on the mortality rate of moving and stationary insects. The calculated results agree closely with the experimental observations of La Mer and co-workers. A.

541.182.

4228. Electronic methods of counting aerosol particles. GUCKER, F. T., JR. AND O'KONSKI, C. T. *Chem. Rev.*, **44**, 373–88 (*April*, 1949).—Two different rapid electronic methods of counting have been developed, the scope and range of which are discussed. The first method depends upon light scattering, and the second upon electrostatic charging of the particles. In the first method a fine stream of the aerosol protected by a flowing sheath of pure air, passes

through a spot under intense dark-field illumination and scatters flashes of light forward upon a photo-sensitive cell. Each particle about 0·6 micron or more in diameter causes an electrical pulse which is sufficiently large, after suitable amplification, to operate a mechanical counter. This apparatus will count particles weighing 5×10^{-13} g, at rates up to 1 000 per minute. A second type of electronic counter depends upon the electrostatic charging of aerosol particles forced at high velocity through a fine jet to impinge upon a metallic collector. The electrical pulses imparted to the collector by particles of 2·5 microns or larger are amplified to operate a mechanical counter. The pulse amplitude is $\propto$ the square of the particular diameter. This empirical fact is explained in terms of the charging mechanism. Both counters may be applied to determine the size of the aerosol particles by using suitable electrical discriminators. The electrostatic device may be very useful for larger particles, while improvements in the photoelectronic counter may make it applicable to particles even smaller than those counted at the present time. A.

ADSORPTION 541.183

541.183

4229. The independence of van der Waals and exchange adsorption on aluminium oxide. HESSE, G. AND SAUTER, O. *Naturwiss.*, **34** (*No.* 8) 250 (1947) *In German.*—Experiments were conducted to distinguish between van der Waals (I) and exchange adsorption (II). Azobenzene was used as the neutral substance for testing for I and *p*-aninobenzene and Sudan-III as the basic and acidic dyestuffs respectively for testing for II. All aluminas prepared from the same starting material by treatment with acids and alkalis gave the same adsorption of azobenzene, but with rising *p*H the acid dyestuff shows a falling and the basic dyestuff a rising adsorption. This is believed to show that I occurs on different places on the surface from II. S. J. G.

541.183

4230. The dependence on *p*H of the adsorption of acids and bases. HESSE, H. AND SAUTER, O. *Naturwiss.*, **34** (*No.* 8) 251 (1947) *In German.*—According to Schwab [*Angew Chem.*, **50**, 546, 691 (1937)] adsorption of A^+ (or B^-) is only possible if the adsorbent surface has an ion C^+ (or D^-) which it can exchange with the solution. This leads to the surprising conclusion that for amphoteric adsorbents, organic acids are better adsorbed from acid media and organic bases from alkaline media. Charcoal, a non-polar adsorbent, shows the same behaviour because in acid solution the organic acid is present as RH which is well adsorbed, whereas in alkaline solution it gives R ions which are badly adsorbed due to hydration. S. J. G.

541.183

4231. A note on the mathematics of adsorption in beds. AMUNDSON, N. R. *J. Phys. Coll. Chem.*, **52**, 1153–7 (*Oct.*, 1948).—A complete mathematical solution of the problem of adsorption occurring irreversibly at a local rate given by Hinshelwood's equation is developed. A. J. M.

541.183

4232. Elution equations for adsorption and ion exchange in flow systems. HIESTER, N. K. AND VERMEULEN, T. Letter in *J. Chem. Phys.*, **16**, 1087–9 (*Nov.*, 1948).—The typical elution bell (the concentration-time curve displaying a maximum) has been fitted with general kinetic equations for any fractional extent of previous saturation by an extension of the method used by Thomas for an initially fully saturated bed. W. R. A.

541.183.02

4233. The adsorption of water vapor on glass surfaces. RAZOUK, R. I. AND SALEM, A. S. *J. Phys. Coll. Chem.*, **52**, 1208–27 (*Oct.*, 1948).—The adsorption isotherms of water vapour (and occasionally of methanol vapour) on known areas of glass were measured by a volumetric method; the glass was in the form of wool, powder and microspheres respectively, and it was outgassed at 200°. Sigmoid isotherms were obtained in each case. Treatment of the glass wool and powder with 2N HCl increased the adsorption 6-fold, and of the microspheres 1½-fold, whereas washing with water decreased it somewhat. All 3 forms of glass showed irreproducible hysteresis; but after saturating with water vapour in an ordinary run and then outgassing thoroughly at 15°, a reversible isotherm (*I*) was obtained which fell below the first by a constant amount, *a* cm³; *I* is ascribed to physical adsorption of a layer on top of a chemisorbed layer, the latter containing *a* cm³. The area of the glass calculated by application of the BET equation to *I* lies close to that calculated from *a*, and is some 20 times the apparent area for the wool and powder and about twice for the microspheres. The minimum two-dimensional compressibility of the water film is 0·0035 C.G.S. units. S. J. G.

541.183.26 : 531.724

4234. Studies of metal surfaces by low-temperature gas adsorption. EMMETT, P. H. *Proc. Pittsburgh Internat. Conf. Surface Reactions*, 82–90 (1948).—It is possible to obtain a reliable estimate of the absolute surface area of a solid by measuring the low-temp. adsorption isotherms of suitable inert gases, such as N, near the boiling point of the gas. Estimates made by 2 methods using different assumptions do not usually differ by more than 10%, and the values are confirmed by electron micrographs and other methods. Different gases can be used for materials having different total surface areas, examples being A, O, N, CO, CO_2, butane, Kr, methane, ethylene and ethane. Examples are given of the use of the method, including the determination of the surface roughness of electrodeposited metals. The usefulness of the knowledge of surface roughness and true surface areas in corrosion studies is emphasized. M. A.

541.183.3 : 541.64

4235. Preferential adsorption and diffusion of light by solutions of macromolecules in certain binary mixtures. KUNST, E. *C.R. Acad. Sci., Paris*, **227**, 837–8 (*Oct.* 27, 1948) *In French.*—Solutions of polystyrolene in C_6H_6, in $CHCl_3$ and in CCl_4 to which

EtOH has been added show preferential adsorption of solvent which decreases in the order C_6H_6, $CHCl_3$, CCl_4. No such adsorption is displayed when n-C_6H_{14} is used as precipitant. Dimensions of the molecule have been determined and the distance between terminal segments becomes smaller as the concentration of precipitant is increased; until at the limit of precipitation addition of EtOH and n-C_6H_{14} both yield the same values. This value is still ~ twice that given by Kuhn and it is therefore considered that a potential barrier of ~ 1·8 Kg-cal exists. W. R. A.

ATOMIC THEORY 541.2

541.23

4236. Report of Committee on Atomic Weights. LUNDELL, G. E. F. *J. Amer. Chem. Soc.*, **71**, 1141–2 (*April*, 1949).

541.23 : 539.155.2

4237. Natural variations in the isotopic content of boron and its chemical atomic weight. THODE, H. G., MACNAMARA, J., LOSSING, F. P. AND COLLINS, C. B. *J. Amer. Chem. Soc.*, **70**, 3008–11 (*Sept.*, 1948).—The isotopic constitutions of boron minerals have been investigated by mass spectral methods involving BF_2^+ and B^+ ions from BF_3 prepared from the mineral. The ratio $B^{11} : B^{10}$, measurable with a precision of ±0·1%, varies from 4·27 to 4·42, depending on the parent mineral. Chemical atomic weight is shown to vary in a corresponding manner. W. R. A.

541.25

4238. Apparent molal volume of sodium in liquid ammonia. STOSICK, A. J. AND HUNT, E. B. *J. Amer. Chem. Soc.*, **70**, 2826–7 (*Aug.*, 1948).—Redetermination of the apparent molal volume of Na in liquid NH_3 confirms the data of Kraus, Carney and Johnson [Abstr. 196 (1928)], but does not confirm Ogg's results [Abstr. 1950 (1946)]. W. R. A.

CHEMICAL STRUCTURE 541.4/.6

541.45

4239. The oxidation of copper and the reactions of hydrogen and carbon monoxide with copper oxide. GARNER, W. E., GRAY, T. J. AND STONE, F. S. *Proc. Roy. Soc. A*, **197**, 294–314 (*June* 22, 1949).

541.57

4240. Factors influencing the strengths of bonds. WALSH, A. D. *J. Chem. Soc.*, 398–406 (*April*, 1948).—The discussion of the factors which are of prime utility for chemists in particular, is in qualitative terms under the heads: electronegativity of bonded groups, bond polarity, overlap of atomic orbitals, repulsion of filled atomic orbitals, and stability of fission fragments. H. H. HO.

541.57

4241. The C–C bond energy in ethylbenzene. SZWARC, M. *J. Chem. Phys.*, **17**, 431–5 (*May*, 1949).

541.57

4242. The electrostatic theory of the hydrogen bond in dicarboxylic acids. MALADIÈRE, P. *C.R. Acad. Sci., Paris*, **226**, 1600–1 (*May* 19, 1948) *In French.*—In a previous note [*ibid.*, **225**, 676 (1947)] it has been shown that electrostatic theory enables the interpretation of certain observations concerning the mode of association of alcohol molecules in solution. The theory is now extended to explain different features of the H bond in carboxylic acids, and in particular of the displacement of vibration frequencies of the bonds of O–H and C=O, of the energy of association, and of the frequency of the symmetrical vibration of molecules with respect to each other. H. H. HO.

541.57 : 536.655

4243. The strengths of certain covalent metal bonds. LONG, L. H. AND NORRISH, R. G. W. *Philos. Trans. A* (*No.* 838) 587–617 (1949).—A method has been evolved for measuring the heats of combustion of spontaneously inflammable substances in the bomb calorimeter and applied to the following compounds: Zn dimethyl, Zn diethyl, Zn di-*n*-propyl, Zn di-*n*-butyl, Cd dimethyl, B trimethyl and Al trimethyl. The samples used were subjected to very thorough purification, revised melting points being given for Cd dimethyl and Al trimethyl. The heats of formation, deduced by the application of additional thermal data, have been listed with all those so far determined for the metal alkyls, and the energies of dissociation and bond energies of the metal-carbon links estimated. This has entailed a recalculation of the heats of sublimation of Al and Sn. From a comparison of the values obtained for the dissociation energies with evidence from spectroscopic and kinetic studies, a definite necessity for taking into account the energies required to promote the various elements to the states of maximum valency is apparent. A.

541.64

4244. Studies in polymerization. IV. The velocity constants in the polymerization of *p*-methoxystyrene. AXFORD, D. W. E. *Proc. Roy. Soc. A*, **197**, 374–82 (*June* 22, 1949).

541.64 : 532.133 : 532.72

Rotatory diffusion constants of flexible molecules. *See Abstr.* 3806

541.64 : 539.374

A theory of viscous deformation in polymers, the volume and surface cohesional energy of the basic moving aggregate. *See Abstr.* 4193

541.65

4245. Influence of the molecular structure of 9,10-diaryldiaminoanthracenes on their optical properties. ZHEVANDROV, N. D., LEVSHIN, V. L. AND MOZGOVA, K. K. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13** (*No.* 1) 49–66 (1949) *In Russian.*

541.651 : 535.343

Effect of alkyl substitution on the spectra and ionisation potentials of chromophores. *See Abstr.* 3871

541.651 : 535.37

Phosphorescence and the rôle of the triplet state in the electronic excitation of complex molecules. *See Abstr.* 3886

541.68

4246. On the defect structure of dinitrocelluloses. PETITPAS, T. *C.R. Acad. Sci., Paris*, **227**, 728 (*Oct.* 11, 1948) *In French.*—Nitrocellulose with ~2·2 nitro groups per C_6 chain has orthogonal axes $a = 14$, b (fibre axis) = 10·4, $c = 8$ Å, specific gravity measured in water 1·66, calculated 1·45. It is suggested that the nitro groups force the cellulose chains apart, so that with incomplete nitration there are $3 - 2{\cdot}2 = 0{\cdot}8$ "holes" per C_6 chain, each absorbing 2 molecules of H_2O in the specific gravity measurement. The discrepancy between calculated and measured values would then be removed. A. J. C. W.

CHEMICAL APPARATUS 542.1/.7

542.2 + 53.07

Laboratory and workshop notes. *See Abstr.* 3739

CHEMICAL PROCESSES 542.9

542.921.4

4247. Isotope effect in the thermal cracking of propane-1-C^{13}. STEVENSON, D. P., WAGNER, C. D., BEECK, O. AND OTVOS, J. W. *J. Chem. Phys.*, **16**, 993–4 (*Oct.*, 1948).—Propane-1-C^{13} was subjected to pyrolysis at 500°C. The relative concentrations of the isotopic methanes, ethylenes and ethanes, and the total concentrations of H, ethylene, ethane, propylene and propane, in the product, were determined mass spectrometrically. Analysis of the results shows that H atoms are preferentially removed from the C^{13} methyl group in the reaction $C_3H_8 + R \rightarrow C_3H_7 + RH$ (R = alkyl radical), i.e. C^{13}–H bonds are more reactive than C^{12}–H bonds; but C^{12}–C^{12} are ruptured 8% more frequently than C^{12}–C^{13} bonds. The reaction is a chain mechanism with 23 links. [See also *J. Chem. Phys.*, **16**, 255 (1948)]. S. J. G.

542.952.1

4248. Mass spectrometric and infra-red study of rates of deuterium exchange, isomerization, and hydrogenation of the *n*-butenes. DIBELER, V. H. AND TAYLOR, T. I. Letter in *J. Chem. Phys.*, **16**, 1008–9 (*Oct.*, 1948).—Rates of formation of deuterobutenes and butane, in Ni-catalysed reactions, were observed in a mass spectrometer, and the rate of isomerization of 1-butene to 2-butene followed by i.r. absorption. Activation energies for isomerization and exchange were $7{\cdot}8 \pm 0{\cdot}7$ kcal, $7{\cdot}1 \pm 0{\cdot}7$ kcal for reaction between D and 1-butene, suggesting that each isomerization is accompanied by an exchange. Subsequent dilution of D by H decreases the apparent exchange rate and increases the isomerization rate, possibly explaining the 6 : 1 isomerization : D exchange rate reported by Twigg [Abstr. 1099 (1941)]. Initially, the ratio isomerization rate : addition rate for D was 20, and for H 2, suggesting different mechanisms for addition and isomerization-exchange. T. G. P.

CHEMICAL ANALYSIS 543/545

545.822

4249. Transport by an electric spark in spectral analysis. SVENTITZKY, N. S. AND TAGANOV, K. I. *Izv. Akad. Nauk, SSSR*, **12** (*No.* 4) 396–401 (*July–Aug.*, 1948) *In Russian.*—The use of an electric spark for the collection of material for spectral analysis is advocated, especially for samples from surface coatings, from permanent fixtures, and from places difficult of access. A pointed Cu or graphite cathode is held 0·5 mm from the sample surface and a quiet spark passed for ½ min whereby the electrode acquires a deposit of the material of the anode surface and the electrode is subsequently used with any desired form of spectral analysis, quantitative or qualitative. D. H. W.

545.824 : 578.088

4250. Use of X-ray and electron diffraction as methods of analysis in biochemical chromatography. CHRIST, C. L., BURTON, C. J. AND BOTTY, M. C. *Science*, **108**, 91–2 (*July* 23, 1948).—Electron diffraction and X-ray diffraction methods were studied for qualitative analysis of amino acids separated chromatographically. Electron diffraction needed only *c.* 200 μg of an amino acid, but even with samples giving fairly uniform patterns, the occurrence of the patterns was often erratic and they were not maintained. X-ray diffraction was much more successful, and excellent patterns were obtained from 50 μg of material by methods described, for over 12 amino acids. E. E. C.

CRYSTALLOGRAPHY 548

548.0 : 535

4251. Study of the optical properties of cerussite at different temperatures. JAFFRAY, J. AND ROCHE, J. *Ann. Phys., Paris*, **4**, 105–21 (*Jan.–Feb.*, 1949) *In French.*—Details are given of the measurement of the coeff. of linear expansion of a thin lamina of cerussite cut perpendicular to the pyramidal plane *P*. The method used was the interference method of Fizeau–Tutton in which observations are made on Newton's rings. The coeff. was found to be $(50 \pm 1) \times 10^{-6}$ per °c between 0 and 150°c. For a crystal cut parallel to *P* the arrangement of Fizeau and Foucault, in which the lamina is placed in azimuth 45° between crossed Nicols and the light emerging from the analyser examined by a spectrograph, was used to study the variation with temp. of the birefringence, order of interference and the exterior angle between the optic axes. The temp. range was from liquid air

temp. to 260°C and the wavelength range 0·36 μ to 0·86 μ. The results are represented graphically and empirical formulae given. H. G. J.

548.0 : 535.4 : 537.533.73

4252. Modern crystal optics. KOSSEL, W. *Optik*, **3** (*No.* 3) 178–200 (1948) *In German.*—A general account of crystal optics, X-ray and electron diffraction, leading to a discussion of the diffraction phenomena observed when a single crystal of Cu is used as an anticathode. The analogous Kikuchi line patterns in electron diffraction are discussed, and also the diffraction effects obtained using very thin single crystal plates and a converging electron beam. M. R. H.

548.0 : 537.311.33

4253. The effective mass of the polaron. LANDAU, L. D. AND PEKAR, S. I. *J. Exp. Theor. Phys., USSR*, **18,** 419–23 (*May*, 1948) *In Russian.*—The assumption is that the current carriers in crystals with ionic lattice are not electrons of the zone of conductivity, but polarons. The conservative movement of the polaron as a whole is considered. The relation between energy of the system and the velocity of the progressive polaron movement is derived, and the equation of movement of the polaron in an external field is given. A.

548.0 : 539

4254. Spontaneous deformation of protocatechuic acid crystals. WOOD, R. W. *Proc. Roy. Soc. A*, **197,** 283–94 (*June* 22, 1949).

548.0 : 539.32

Elastic constants of garnets. *See Abstr.* 4191

548.0 : 539.374

4255. Residual lattice strains in plastically deformed polycrystalline metal aggregates. GREENOUGH, G. B. *Proc. Roy. Soc. A*, **197,** 556–67 (*July* 7, 1949).—The residual lattice strain observed by X-ray diffraction methods in plastically extended polycrystalline aggregates has been investigated. It is shown that, if several diffraction lines are examined, the residual lattice strains vary both in magnitude and in sign. It is known that one of the causes of internal stresses in a plastically deformed polycrystalline aggregate is the variation with orientation of the yield tensions of the crystals in the aggregate. Since only grains with certain orientations contribute to a given diffraction line, the lattice strain measured is not the mean strain in all the crystals, which should be zero, but the average of the strains in those crystals with particular orientations, which may be positive or negative. It is considered that this constitutes one of the reasons for the hitherto unexplained observations which have been made on residual lattice strains. Quantitative conclusions from this explanation are in satisfactory agreement with observations. A.

548.1 : 519.4

4256. Crystal symmetry and physical properties: application of group theory. BHAGAVANTAM, S. AND SURYANARAYANA, D. *Acta Cryst.*, **2,** 21–6 (1949) *In English.*—The method of determining the number of independent parameters required to specify a physical property in each crystal class by means of transformation of co-ordinates is tedious, and a shorter method based on group theory is developed. As already shown [Abstr. 1803 (1943)], the stress-optical constants for crystal classes 4, $\bar{4}$, 4/*m*; 3, $\bar{3}$, 3/*m*; 6, 6/*m*; 23, 2/*m*$\bar{3}$ have ordinarily been wrongly given. There are discrepancies among the third-order elastic coefficients also. A. J. C. W.

548.1 : 519.4

4257. Note on the Bhagavantam-Suryanarayana method of enumerating the physical constants of crystals. JAHN, H. A. *Acta Cryst.*, **2,** 30–3 (1949) *In English.*—The results of Abstr. 4256 (1949) are confirmed by a different and somewhat shorter method. A. J. C. W.

548.5

4258. The growth of crystals. THOMSON, G. P. *Proc. Phys. Soc., Lond.*, **61,** 403–16 (*Nov.*, 1948).—The 1948 Guthrie Lecture. Surveys the work on, and the ideas of, crystal growth. Thermodynamic approach (consideration of free energy) has limitations, and the treatment of the formation of embryos in terms of separation and surface energy by the "unit-cube" model gives a rate of growth much slower than that observed. Existence of a mobile saturated layer covering the surface would explain the higher rate, the surface not now being one of constant concentration. Experimental evidence for the layer is cited (including some new work). Discusses stepwise and dendritic growth, the orientation of deposited films, and the general question of the growth of one crystal upon another. A. J. K.

548.52 : 541.124

4259. The preparation of single crystals for the study of surface reactions. GWATHMEY, A. T. *Proc. Pittsburgh Internat. Conf. Surface Reactions*, 66–70 (1948).—Four methods of growing single crystals are considered: (i) from the molten metal, (ii) in the solid state by the strain-anneal method, (iii) by deposition from the vapour, and (iv) by electrodeposition. For the study of the reaction of metals with gases or liquids the single crystals are converted into spheres (with a shaft extending from one point). In this way all possible crystal faces are exposed and it is possible to study the correlation between initial structure, changes in structure, and chemical activity. Machining and polishing methods are detailed for single crystals of Cu, Au, Al, Ni, Ag, Cr, Cd, Zn, Bi, Sn, Fe, Pb, In. The two latter cannot be machined or mechanically polished without recrystallization. Electrolytic polishing is to be preferred for final surface preparation. During the study of a number of gas–metal reactions, it was found that definite facets are produced on a single crystal depending on the metal, the gas, and the crystal plane parallel to which the original surface was prepared, and within limits, independent of the initial surface preparation. M. A.

548.522

4260. Investigation of zinc crystals obtained by sublimation. GEIST, D. *Acta Cryst.*, **2,** 13–14 (*March* 1949) *In German.*—The production and appearance of Zn crystals grown by sublimation is described. The crystals show a layer structure with layers parallel to a hexagonal base plane, which is obtained in air as well as in A. The thickness of these layers is determined by interferometry under a microscope.

Thickness values ranging from 2 microns down to 200 Å have been observed. H. MO.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

4261. Theory of the crystalline state. PERELESHIN, A. S. *J. Exp. Theor. Phys., USSR*, **18**, 449–56 (*May*, 1948) *In Russian.*—The crystal considered has a structure corresponding to that of the kinetic equation of Vlassov. It is shown that beginning from a certain minimum temp. the periodic distribution of the density in such a crystal is discontinuous, and that these discontinuities persist during a further rise of temp. A.

548.7

4262. Bifurcated hydrogen bonds. WELLS, A. F. *Acta Cryst.*, **2**, 128–9 (*April*, 1949) *In English.*—The hypothesis of "bifurcated" hydrogen bonds [Abstr. 465 (1941)] is unnecessary; secondary I–O bonds form a more satisfactory interpretation of the short O–O distances in α–HIO_3. A. J. C. W.

548.7 : 539.133

Interatomic distances in certain crystals. *See Abstr.* 4112

548.7 : 669.018

4263. Quasi-chemical theory of order for the copper gold alloy system. LI, YIN-YUAN. *J. Chem. Phys.*, **17**, 447–54 (*May*, 1949).—Yang's general quasi-chemical theory of superstructure is further generalized in terms of the atomic distribution on sublattices of any number and of any geometrical arrangement. The possibility of the formation of different types of long-distance order due to the different recombinations of sublattices is discussed. By making use of this theory the behaviour of the general Cu–Au system at very low temps. and its phase diagram are shown. The critical temp., latent heat, curve of long-distance order and energy *v.* temp. for the Cu–Au tetragonal crystal are obtained. The results are found to be quite different from those of Shockley's theory. A.

548.73

4264. New structural types with closest packing of the component atoms. BELOV, N. V. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 5) 677–80 (1949) *In Russian.*

548.734.2

4265. Crystal setting by X-rays. JEFFERY, J. W. *Acta Cryst.*, **2**, 15–21 (*March*, 1949) *In English.*—A method utilizing Laue streaks for the setting of crystals by means of an X-ray goniometer is described in detail. The problem is to bring a given reciprocal lattice plane into the equatorial position relative to a rotation axis. This is achieved by taking an oscillation photograph and then another, on the same film, with the crystal rotated by 180°. At one end of the oscillation the crystal is stopped for some time to define sharply the end of the streaks. General formulae are given for calculating the corrections to be applied to the goniometer arc settings. The data for this calculation are obtained from the double oscillation photograph. The method is compared with others used by previous workers. It is claimed that the author's method can be used when others fail. The errors of crystal setting are estimated and the formulae used are proved. An example for the application of the method is given and worked out in detail. H. MO.

548.734.84 : 535.4 : 537.531

X-ray absorption in diffracting crystals. *See Abstr.* 4012

548.735.4

4266. *X*-ray study of potassium iridium trioxalate. RAPPENEAU, P. *Bull. Soc. Franç. Min.*, **68**, 44–59 (1945) *In French.*—X-ray examination gives the following cell dimensions for the hexagonal crystal: *a* 10·95 ± 0·03, *c* 10·38 ± 0·02 Å. The space-group is D_3^4 and D_3^5, corresponding to the left- and right-handed crystal, respectively. B. A.

548.735.4

4267. Domain structure of $BaTiO_3$ crystals. BLATTNER, H., KÄNZIG, W., MERZ, W. AND SUTTER, H. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 207–9 (1948) *In German.*—Optical and X-ray measurements were made between 18° and the Curie point (120°C). Above the Curie point the elementary crystal cell is cubic, below it the spontaneous polarization begins, and the crystal structure presents polarized tetragonal domains which are twinned along the (011) planes. Photomicrographs of the crystals are shown. F. L.

548.735.4

4268. Table of interplanar spacings in Angstrom or K.X. units in terms of 2θ for different target materials. BEATTY, S. VAN D. Letter in *Phys. Rev.*, **74**, 625–6 (*Sept.* 1, 1948).—The tables, available from Westinghouse Research Laboratories, East Pittsburg, Pa., U.S.A., give *d* in Å and *kX* for Mo, Cu, Co, Fe, Cr radiations and values of 2θ 5° (0·1) 70° (0·2) 80° (0·5) 85°. A. J. C. W.

548.735.4

4269. Table of interplanar spacings for different target materials for the back reflection region. BEATTY, S. VAN D. *Phys. Rev.*, **75**, 700 (*Feb.* 15, 1949).

548.735.4

4270. A photoelectric device for the evaluation of structure factors. LIPSON, H. AND TAYLOR, C. A. *Acta Cryst.*, **2**, 130 (*April*, 1949) *In English.*—Holes of areas $\propto$ the atomic scattering factors are drilled at the appropriate positions in a brass template, and light is projected through a mask of sinusoidally varying density [Abstr. 2577 (1945)] and the template on to a barrier-layer photocell. With the sensitivity and zero properly adjusted, the deflection of a galvanometer connected to the photocell gives both the sign and magnitude of the structure amplitude corresponding to the mask used. A. J. C. W.

548.735.42

4271. The refinement of atomic parameters by the technique known in X-ray crystallography as 'the method of steepest descents.' BOOTH, A. D. *Proc. Roy. Soc. A*, **197**, 336–55 (*June* 22, 1949).—A discussion of the normal methods of structure analysis results in a formulation of the problem as one of minimization, and leads naturally to the idea of optimum procedures for this purpose. Three

techniques are derived from a unified presentation: (*a*) the "relaxation" method, (*b*) the "least squares" refinement, (*c*) the method of "steepest descents." These are examined in detail and their virtues and defects noted. A complete discussion of the application of the steepest descent procedure to various types of structure analysis is given and techniques are derived for the cases of: refinement of a set of parameters already reasonably good; refinement of a structure where general configuration but not orientation is known; and refinement of structures given by electron densities on a lattice. Several variants of the process are given, in one of which only those planes of zero observed intensity being used; this gives a process which is independent of phase angle values, and should be useful in the case of structures for which no chemical data are available. A.

548.734.44

4272. A method for the determination of crystal cuts by applying the reflection of X-rays on a known lattice plane. PETRŽÍLKA, V. AND BENEŠ, J. *Bull. Int. Acad. Tchèque Sci.*, **46**, 167–78 (1945) *In English.*—A small notch is made in the knife edge of a Seemann spectrograph, and reflections from a plane making a small angle with the cut face recorded, the plate being turned through 180° about its normal partway through the exposure. The orientation of the cut face relative to the lattice plane is calculated from the horizontal distance between the two reflections and the vertical distance between the darker points corresponding to the notch. Alternatively, part of the exposure can be made with a plate of known orientation, the rest with the plate under investigation. An accuracy of 1′ is claimed. [Also in *Phil. Mag.*, Abstr. 1358 (1947)]. A. J. C. W.

548.735.44

4273. On apt system to improve the results of the structural investigations of crystals with Fourier analysis. BEZZI, S. AND CROATTO, U. *Ric. Sci.*, **18**, 99–100 (*Jan.–Feb.*, 1948) *In Italian.*—The authors describe a procedure introducing a fictitious temperature factor $\varepsilon^{-B(\sin\theta/\lambda)}$ in the Fourier series, thereby eliminating the Gibb's phenomenon, and making the short wavelength terms of the series more convergent. H. P. M.

548.736.1 : 539.27

Experiments on the lattice building elements of solid bodies. *See Abstr.* 4184

548.736.4

4274. The orientations of Böhm planes in crystals of quartz. SAVUL, M. *Bull. École Polyt. Jassy*, **3**, 375–97 (*Jan.–June*, 1948) *In French.*—Previous work on this subject is described. The orientations of the Böhm planes, with respect to the optic axis were determined for a large number of granules of quartz and the following conclusions drawn: (1) The migration of the optic axis, supposed by Hietanen [*Bull. Comm. Géol., Finland* (*No.* 122) (1938)] in crystals still possessing bipyramidal faces [10$\bar{1}$1] was not observed. (2) Böhm planes have different orientations. They develop in series of connecting planes which are arranged with their poles on a great circle, preferably the circle [02$\bar{2}$1], or at the points of intersection of this zone circle and those given by Niggli's rule for quartz. [*Zeit. f. Krist*, **63**, 294 (1926)] (3) Böhm planes were found, in order of frequency of occurrence, in the region of the following poles: [10$\bar{1}$2], [$\bar{1}$2$\bar{1}$6], [3$\bar{1}\bar{2}$2], [10$\bar{1}$4]. H. P. M.

548.736.44

4275. Extra reflexions from $NaClO_3$ single crystals. SEN, R. K. *Acta Cryst.*, **2**, 127–8 (*April*, 1949) *In English.*—The measurements of Garrido [Abstr. 171 (1948)] are not in accord with the theory of Jahn [Abstr. 1091 (1942)]. A. J. C. W.

548.736.

4276. The lattice-constant of some reflecting planes in quartz. BROGREN, G. *Ark. Mat. Astr. Fys.*, **36B**, *Paper* 3, 3 *pp.* (1948) *In English.*—Gives the results of spacing determinations carried out on the (10$\bar{1}$1) and (13$\bar{4}$0) planes of quartz in connection with the use of this material in a curved crystal spectrograph. The figure given for (10$\bar{1}$1) is 3336·264 X.U. and for (13$\bar{4}$0) is 1177·621 X.U. at 18°C. The temp. correction factor is given in each case. J. T.

548.736.

4277. Determination of the lattice constant of quartz 10$\bar{1}$1. BROGREN, G. AND FRISKOPP, K. G. *Ark. Mat. Astr. Fys.*, **36B**, *Paper* 4, 5 *pp.* (1948) *In English.*—Describes the experimental arrangement used in arriving at the results quoted in the previous abstract, with special reference to the (10$\bar{1}$1) plane. A new value is obtained for the spacing, namely 3336·274 X.U., with a max. error of 0·03 X.U. J. T.

548.73

4278. A note on the structure of insulin. WRINCH, D. *J. Chem. Phys.*, **16**, 1007–8 (*Oct.*, 1948).—A complete 3-dimensional Patterson–Harker synthesis has been carried out for "wet" insulin crystals on the basis of the intensities recorded by Crowfoot (not yet published in detail). The Patterson–Harker "sections" indicate that there is a low electron density within the insulin molecule and it is suggested that this is in favour of the cyclol "cage" structure for soluble proteins postulated by the author. [See Wrinch *Proc. Roy. Soc. A*, **161**, 505 (1937); and Abstr. 3895 (1938)]. J. I.

548.737

4279. Crystal structure of *d*-tartaric acid. BEEVERS, C. A. AND STERN, F. *Nature, Lond.*, **162**, 854 (*Nov.* 27, 1948).

548.74

4280. Some experimental values of the atomic scattering factor. Thermal vibrations and lattice distortion in pure and mixed crystals. WASASTJERNA, J. A. *Comment. Phys. Math., Helsingf.*, **13** (*No.* 5), 24 *pp.* (1948) *In English.*—Atomic scattering factors of alkali and halogen ions were determined. For F^- and Na^+ ions the experimental values agree with the (Hartree method) theoretical values within the limits of experimental errors. The systematic differences are more pronounced in the case of K^+ and Cl^-, and still more so for Rb^+. However, for Br^-, Rb^+, I^- and Cs^+ the experimental values agree with those calculated in accordance with the Thomas–Fermi field. For pure alkali halides mean values of the squares of the total displacements of ions from their theoretical positions are due to thermal vibrations. For mixed crystals KCl–KBr and KCl–RbCl

the values of mean displacements cannot be explained solely by thermal vibrations, and the actual equilibrium positions do not coincide with the corresponding positions of the ideal lattice. The lattices of mixed crystals are characterized by a geometrical long-range disturbance which causes a mean displacement τ_x of all ions in any direction x. Ions which are surrounded by ions of different kinds show a superimposed local mean displacement σ_x. The values obtained are: $\sigma_x = 0{\cdot}08$ Å; τ_x (KCl–KBr) $= 0{\cdot}05$ Å; τ_x (KCl–RbCl) $= 0{\cdot}03$ Å. F. L.

548.74

4281. The structure and epitaxy of lead chloride deposits formed from lead sulphide and sodium chloride. Elleman, A. J. and Wilman, H. *Proc. Phys. Soc., Lond. A*, **62**, 344–55 (*June*, 1949).—Electron diffraction shows that $PbCl_2$ is formed instead of $PbO \cdot PbSO_4$ when mosaic single-crystal PbS layers a few 100 Å thick are heated on their NaCl substrates in air at 200–300°c. The structure and orientation of these $PbCl_2$ layers are described. This example of epitaxial crystal growth is particularly interesting because the atoms adjacent to the, at least initially, atomically smooth PbS surface do not lie exactly in a single close-packed plane atomic sheet, but the atomic arrangement closely matches that of the PbS substrate in a series of parallel bands. When the composite $PbCl_2$–PbS layers were isolated from their NaCl substrate the transmission patterns showed that they must have partly broken up, leading to curvature about remarkably well-defined axes parallel to the film plane and PbS cube-face diagonals. A.

GEOPHYSICS 55

550.312

4282. Recent advances in the technique of submarine gravity surveying. Cooper, R. I. B. *Proc. Roy. Soc. A*, **197**, 523–45 (*July* 7, 1949).—The errors in gravity surveying at sea which are the most difficult to estimate are involved in position-finding, measurement of speed over the ground, the variations of depth-keeping and in the second-order correction. Submarine gravity surveying is also a slow process on account of the time required for an observation with the standard Vening Meinesz 3-pendulum apparatus and the complications of computing the result. During the recent cruise in the English Channel in May, 1948, of H.M. Submarine *Talent* most of these difficulties were overcome by the provision of special instruments which are described here. The most important of these was a stabilizer which, by automatically compensating the effect of sideways accelerations on the pendulums, removed the necessity for certain tedious corrections and enabled the results to be rapidly computed. A.

550.312 : 526.7

Attempts to replace the elastic comparison force in gravimeters by capillary or electrostatic forces. *See Abstr.* 3737

550.345

4283. On the large displacements commonly regarded as caused by Love-waves and similar dispersive surface-waves. IV. Scholte, J. G. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 8) 969–76 (1948) *In English.*—Previous work [Abstr. 1451 (1947)] is extended to waves reflected at an interface, and an expression obtained for the disturbance due to the Stoneley wave shows that this may be a major factor in the ocean movement caused by a shock in the subjacent medium. Other surface waves can be formed by the interference of several reflected waves if the primary impulse is not of too short duration. A. HU.

550.36 : 539.18

Thermal consequences of the capture of neutrinos by the earth. *See Abstr.* 4164

550.362 : 537.311.33

Electrical conductivity of rocks at high temperatures. *See Abstr.* 3989

550.367 : 539.163

4284. Significance of the radioactivity of potassium in geophysics. II. Gráf, T. Letter in *Phys. Rev.*, **74**, 831–2 (*Oct.* 1, 1948).—[Revision of Abstr. 205 (1948)]. The revised value for the $\frac{1}{2}$-life of K^{40} [Abstr. 680 (1949)] leads to a calculated rate of radioactive heat production by K^{40} of $(22 \pm 3) \times 10^{-6}$ cal/yr/gm K, or about 0·11 of the total radioactive heat, assuming an average K content of acidic igneous rocks of 0·028. The suggestion of Suess [Abstr. 3428 (1948)] is discounted, as loss of A from K minerals during recent geological time was neglected. The new value leads to an adequate explanation of the origin of atmospheric A. At the genesis of the earth, the rate of heat production by K was probably $>10\times$ that of the total radioactivity in the earth's crust to-day. A. O. S.

550.37

4285. Influence on atmospheric electrical field of surface space charge. Meinhold, K. H. Letter in *Naturwiss.*, **34** (*No.* 8) 249 (1947) *In German.*—Measurements on Danzig Bay, 1940–45, with an electrostatic voltmeter during the onset of the sea breeze in fine weather show a 50% increase of field strength in a few min. This may be due to different conditions existing previously over the sea or to turbulence of sand over the Dunes. Berlage had found a decrease of field strength during the onset of the sea breeze in the Netherlands Indies. A further indication of the importance of surface space charge was given by the large differences indicated by two electrostatic voltmeters only 50 m apart during thundery showers. R. S. R.

550.38

4286. Electromagnetic induction phenomena in a spherical conductor. Geophysical applications. Cagniard, L. *Ann. Fac. Sci. Univ., Toulouse*, **8**, 59–88 (1947) *In French.*—Lamb's hypothesis is that the earth's magnetic field can be explained by a very

slowly decaying electrical current induced at a certain moment in the past in the globe's metallic nucleus when an exterior magnetic field suddenly vanished. A new solution of the problem of the gradual decay of these induced currents is given. This is much simpler than Lamb's solution, and it allows the currents to be studied numerically. It is proved that the exterior magnetic field of decaying electrical currents must be identical with that of an infinitesimal magnet located at the earth's centre. M. R.

550.38

4287. The secular change in the earth's magnetic field. BULLARD, E. C. *Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **5**, 248–57 (*July*, 1948).—The hypothesis that the secular change is due to electric currents induced in the material of the core by its movement through the general magnetic field of the earth is examined. Detailed calculations are made for the focus of rapid change in South Africa. It is shown that many of the observed facts can be accounted for by a circular motion with a diameter of a few 100 km situated near the surface of the core. To get numerical agreement the field at the core has to be assumed > seems probable. The magnetic axis of the eddy is approximately horizontal and points N. 45° W. A.

550.38

4288. The magnetic field produced by earth currents flowing in an estuary or sea channel. BARBER, N. F. *Mon. Not. Roy. Astr. Soc. Geophys. Suppl.*, **5**, 258–69 (*July*, 1948).—Records made in the Clyde estuary of fluctuations of the earth's magnetic field, and of simultaneous fluctuations in the horizontal potential gradients in the water, give a clear indication that the fluctuations in vertical intensity are largely due to a varying flow of electric current in the sea. Variations in the earth current in the English Channel appear to produce appreciable fluctuations in vertical intensity at the magnetic observatory at Abinger. A.

550.38

4289. The magnetic field within the earth. BULLARD, E. C. *Proc. Roy. Soc. A*, **197**, 433–53 (*July* 7, 1949).—The paper discusses the magnetic effects of internal motions in the core of the earth. It is shown that tidal friction, fluctuations in the rate of rotation, nutation, and the variation of latitude have negligible magnetic effects. Precession is also ineffective if Poincaré's theorem on the precession of a liquid sphere in a rigid shell is applicable to the earth. Thermal convection is shown to be likely to occur in the core. The conservation of angular momentum will require it to be associated with a radial gradient of angular velocity which will have a large magnetic effect. Its interaction with the dipole field can produce a toroidal field which is ⩾ the dipole field. The convective and rotational motions can interact with the dipole and toroidal field in a way that tends to reproduce the dipole field. The complete theory has not been worked out, but it seems likely that the interaction is strong enough to maintain the field. The whole process resembles that occurring in a self-exciting dynamo. The existence of a strong field in the core removes the difficulties previously found in the theory of the secular variation. A.

550.384.3 : 523.7

4290. Geomagnetic "crochet" occurrence a Abinger, 1936–46, and allied solar and radio data NEWTON, H. W. *Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **5**, 200–15 (*Jan.*, 1948).—The rather infrequen occurrence at Abinger of geomagnetic "crochets (ultraviolet solar radiation effect) has been studie over 11 years, in conjunction with data of solar flare and radio fade-outs. The trace movements in H, D and V of 23 examples are reproduced, in addition t tabulated data for these and for 32 other cases o less certain identification. The general synchroniza tion of flare, fade-out and crochet (when present) i noteworthy. Comparison is made of the amplitud ΔH and direction ΔD of the crochets with the norma diurnal inequality of H and D. A striking feature i the change in direction from east to west in D a about $10^{h}{\cdot}7$ apparent solar time, in conformity wit the diurnal inequality in D. The correlation with th diurnal inequality in H is less obvious, but ΔH is o the correct sign (negative) over the range of daylig hours in which crochets occurred. There are indi cations of other diurnal and seasonal factors (othe than a simple dependence upon the sun's zenit distance) in the occurrence of crochets at Abinge Some crochets in 1946 have synchronized wit reported bursts of "solar noise." A

550.38

4291. A note on the relationship between the hori zontal components of D_m and D_{st}. CYNK, B. *Ter Magn. Atmos. Elect.*, **53**, 291–304 (*Sept.*, 1948).— The physical meaning of D_{miH} is discussed fro observations of international sudden-commencemer magnetic storms. D_{miH} designates the differenc between the mean value of horizontal intensity, H on 5 international quiet days from the correspondin value on 5 international disturbed days in eac month. W. A. E

550.389 : 538.7

4292. A magnetic survey of Norway. TRUMPY, B *Jordmagn. Publ. No.* 1 (*Magnetisk Byrå, Bergen an Norges Sjøkartverk, Oslo*) (1945) *In English.*

550.822 : 539.16.08 : 537.54

Measurement of radioactivity and temperature i narrow boreholes, and the development of instrument for this purpose. *See Abstr.* 4050

550.837.7 : 621.396.1

4293. The attenuation of ultra-high frequenc electromagnetic radiation by rocks. MCPETRIE, J. S SAXTON, J. A.; COOPER, R. I. B. Letter in *Proc Phys. Soc., Lond.*, **61**, 482–3 (*Nov.*, 1948).—Com parison is made between work already published McPetrie and Saxton [Abstr. 877 B (1945)] and th work of Cooper [Abstr. 4056 (1948)], close agreemen of results being shown. G. F. H

550.93 : 539.163.

4294. Actino-uranium and geological time. ERÖS, N *Bull. Soc. Roumaine Phys.*, **47** (*No.* 84) 29–32 (1946 *In French.*—The disintegration constants and presen relative abundances of U^{235} and U^{238} are used t estimate the age of the earth as $\sim 0{\cdot}4 \cdot 10^{10}$ years assuming that the initial abundances were in th ratio 1 : 10. The estimate is little affected by con siderable changes in the initial abundance ratio, an

's confirmed by similar calculations for U^{238} and Th^{232}. R. A. N.

551.1 : 523.4

4295. On the constitution of the terrestrial planets. RAMSEY, W. H. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 5) 406–13 (1948).—It is suggested that the density jump at the boundary of the earth's core is due to a pressure transition from the molecular to a metallic phase, rather than to the appearance of a new material such as an alloy of iron and nickel. The pressure at the boundary of the core will then be characteristic of the chemical composition of the material, and so may be assumed to be the same for all the terrestrial planets. The mean densities of the terrestrial planets calculated on the basis of this assumption are in good, but not perfect, agreement with the empirical values. The calculated ellipticity of Mars is also satisfactory. If allowance is made for the tendency of the heavier elements to gravitate towards the centre of the earth, the small discrepancies in the calculated mean densities can be removed. A.

551.11 : 526.15/.17

The figure of the earth. *See Abstr.* 3735–6

551.38

4296. The "absolute quadrupole moment"—a magnetostatical fundamental quantity, and its geophysical significance. MACHT, H. G. *Z. Naturforsch.*, **3a**, 189–95 (*April*, 1948) *In German.*

551.46 : 532.72

4297. Note on eddy diffusion in the sea. RICHARDSON, L. F. AND STOMMEL, H. *J. Met.*, **5**, 238–40 (*Oct.*, 1948).—The theory of eddy diffusion is briefly reviewed. In place of Fick's diffusion equation, the authors employ the equation $\partial q/\partial t = \partial/\partial l[F(l)\partial q/\partial l]$, where l is the projected separation of a pair of marked particles in any fixed direction, and $F(l)$ is the "diffusivity for neighbours," and show that observations of the relative motion of two pieces of parsnip floating on the sea lead to the empirical result $F(l) = 0{\cdot}07\, l^{1{\cdot}4}$ which is in accord with the law deduced from atmospheric observations, and with the 4/3 power law deduced by von Weizsäcker and Heisenberg for the case of turbulence with large Reynolds number. J. S. G. T.

ATMOSPHERE . METEOROLOGY 551.5

551.51 : 523.4

4298. The atmospheres of the earth and planets. KUIPER, G. F. (edited by). *Chicago, University of Chicago Press*; *London, Cambridge University Press*; *Toronto, W. J. Gage and Co.*, viii + 366 *pp.*, 16 *plates* (1949).—A symposium of papers by 18 authors. Subjects dealt with are: circulation of the lower atmosphere, scattering in planetary atmospheres, rocket research programmes, seasonal variations in the upper atmosphere, spectra of night sky and aurorae, the atmosphere above 300 km, the evolution of earth's atmosphere, i.r. spectroscopy, spectroscopic observations of the planets, a survey of planetary atmospheres, long-path laboratory spectra, and the possibility of photosynthesis on Mars.

551.510.4

4299. The abundance and temperature of methane in the earth's atmosphere. MCMATH, R. R., MOHLER, O. C. AND GOLDBERG, L. Letter in *Phys. Rev.*, **74**, 623–4 (*Sept.* 1, 1948).—Analysis of equivalent widths of lines within P and R branches of the $2\nu_3$ band of atmospheric CH_4 at $1{\cdot}666\ \mu$ has yielded estimates of mass abundance and average temp. of the gas, viz. 1·2 parts per million and −37 C respectively. The latter value corresponds to that found normally at 8 km. D. R. B.

551.510.4

4300. Winter measurements of ozone over the Organ Mountains, New Mexico. STAIR, R. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 145–52 (*Feb.*, 1949).—Gives data on the total amount of O_3 from December 16 to 19, 1947, and from January 6 to 8, 1948, as determined from solar ultraviolet measurements by a phototube and filter method. The measurements indicate O_3 in the stratosphere in an amount equivalent to a layer about 0·19 cm in thickness at normal temp. and pressure for each of the two periods. A.

551.510.52

4301. The thermal equilibrium at the tropopause and the temperature of the lower stratosphere. GOODY, R. M. *Proc. Roy. Soc. A*, **197**, 487–505 (*July* 7, 1949).—Further considerations along the lines of Emden's methods lead to continuity of temp. at the tropopause as a condition for a stable transition from a state of convective to radiative equilibrium. This explains the characteristic appearance of the temp. distribution near the tropopause. Application of this condition leads to a simple explanation of the latitude variation of stratosphere temp., mainly in terms of the effects of H_2O vapour and CO_2. The variation of stratosphere temp. with O_3 concentration may be calculated, which confirms Dobson's hypothesis that anomalous seasonal variations in stratosphere temp. are due to seasonal variations of O_3 concentration. Reasons for the approximately isothermal character of the lower stratosphere are also discussed. A.

551.510.535

4302. Tides in the upper atmosphere. BURKARD, O. *Terr. Magn. Atmos. Elect.*, **53**, 273–7 (*Sept.*, 1948) *In German.*—Hourly values of the normal incidence critical frequency of region F_2 for Washington in 1945 are analysed for evidence of lunar periodicity. A lunar tidal oscillation is found of amplitude ±85 kc/s with max. nearly 1 hr before lunar transit (average values over the year). The corresponding relative pressure oscillation at 300 km amounts to 0·0342 which is some 3 000 times > the ground value. W. J. G. B.

551.510.535

4303. A panoramic ionospheric recorder. STOFFREGEN, W. *Terr. Magn. Atmos. Elect.*, **53**, 269–71 (*Sept.*, 1948).—A brief statement is given of the principles of a panoramic ionospheric recorder covering the frequency range 1·4 to 14 Mc/s. Details of the construction of the equipment are not given but some sample records are reproduced. W. J. G. B.

551.510.535

4304. Lunar tidal oscillations in the ionosphere. APPLETON, E. V. AND BEYNON, W. J. G. Letter in

Nature, Lond., **162**, 486 (*Sept.* 25, 1948).—Semi-diurnal lunar tidal oscillations are found in region F_2 height and critical frequency data for a station in latitude 51½° N. The amplitudes of the oscillations are about 2 km in height, the max. occurring approximately mid-way between lunar transits and 0·05 Mc/s in critical frequency with a max. value just before lunar transit. The phase of the lunar oscillation in the height of region F_2 is quite different from that previously found for region E at the same site.

W. J. G. B.

551.510.535

4305. State of the upper atmosphere. SEATON, S. L. *J. Met.*, **5**, 204–19 (*Oct.*, 1948).—This paper lays the foundation for development of upper-atmosphere meteorology between heights of 90 and 400 km on the basis of ionospheric measurements. A theory is outlined whereby measurements of the ionosphere permit deduction of 5 quantities descriptive of the state of the high atmosphere. Application of the theory is made to data from 18 widely separated locations over the earth for January, 1947. Calculations are presented and used in construction of isopleths on a world-wide scale. It is found that cells of high and low temp. are systematically developed in N and S hemispheres. Results are compared with findings of other investigators. It is shown that the recombination coeff. between electrons and positive ions is not pressure-sensitive within an ionospheric layer and is not dependent upon the electron density. Temperature gradients found suggest strong wind systems, pronounced convection currents and considerable turbulence. A.

551.510.535

4306. Short-period changes in the F region of the ionosphere. MUNRO, G. H. Letter in *Nature, Lond.*, **162**, 886–7 (*Dec.* 4, 1948).—Continuous ionospheric observations at 3 sites at distances 13, 27 and 30 miles apart, indicate horizontal motions in region F_2 with velocities between 3 and 5 miles/min. The effects observed may be due either to horizontal drifts in the ionosphere, with superimposed local variations in ionization gradient, or to a progression of a wave motion (e.g. a pressure wave). The evidence presented is considered to favour the latter explanation. [See also Abstr. below]. W. J. G. B.

551.510.535

4307. Evidence of horizontal motion in region F_2 ionization. BEYNON, W. J. G. Letter in *Nature, Lond.*, **162**, 887 (*Dec.* 4, 1948).—A comparison of relative field strength measurements of signals received from a short-wave broadcast station at a site 990 km away, with continuous normal incidence ionospheric observations, indicates a rapid horizontal motion of, or within, region F_2 ionization at certain periods. The horizontal velocity is estimated to be about 430 km/hr. [See also Abstr. above].

W. J. G. B.

551.510.535 : 551.594.12

4308. A note on the ionic composition of the upper atmosphere. BATES, D. R. AND MASSEY, H. S. W. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 48–50 (1948).

551.510.535 : 551.594.

4309. Report on recent work on ionospheric phenomena and on solar and terrestrial relationships. VEGARD, L. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 82–91 (1948).—A detailed summary of work undertaken at Oslo since 1940 by the author and his collaborators. Reference is made to the variability of intensity distribution in the spectra of aurorae: determination of ionospheric temps. from intensity distributions within the R branch of aurora negative N_2 bands: origin and excitation of the Na doublet at twilight. D. R. B.

551.510.535 : 621.396.11

4310. On the localization of sporadic E ionization in the upper atmosphere. REVIRIEUX, P. *C.R. Acad. Sci., Paris*, **227**, 79–81 (*July* 5, 1948) *In French.*—Particulars are given of observations of radio communication on frequencies near 60 Mc/s over distances of about 1 000 km during June, 1948. The sharp directional characteristics of the observations indicate that the signals were reflected from areas of sporadic E ionization of quite limited dimensions. W. J. G. B.

551.510.535 : 621.396.11

4311. Remarks on the localization of sporadic E ionization in the upper atmosphere. LEJAY, P. *C.R. Acad. Sci., Paris*, **227**, 81 (*July* 5, 1948) *In French.*—Normal incidence ionospheric observations made in June, 1948, at Paris, support the suggestion made in the paper by Revirieux [Abstr. 4310 (1949)] that reflections from localized regions of sporadic E ionization gave rise to the observed abnormal radio transmission phenomena. W. J. G. B.

551.510.535 : 621.396.9

4312. A new unit for the systematic investigation of ionospheric characteristics. BOLLE, A. *Ann. Geofis.*, **1**, 164–74 (*April*, 1948) *In Italian.*

551.51

4313. On the concept of frontogenesis. MILLER, J. E. *J. Met.*, **5**, 169–71 (*Aug.*, 1948).—The intensity of frontogenesis is defined as the rate of increase of the gradient of a scalar property S. Starting from this definition different expressions are derived to represent frontogenesis, according as the term is applied to strictly horizontal motions in the atmosphere or to motions involving vertical as well as horizontal components. The meaning and relative importance of the various terms appearing in the most general expression for frontogenesis are discussed and explained: and it is concluded that there is lack of consistency in the usual definitions of the terms frontal zone and frontogenesis. G. G.

551.513

4314. On the production of kinetic energy in the atmosphere. STARR, V. P. *J. Met.*, **5**, 193–6 (*Oct.* 1948).—The production of kinetic energy in the atmosphere is examined from a hydrodynamical point of view. The results indicate that the intensity of the primary source of horizontal kinetic energy at any point in the atmosphere is equal to the pressure multiplied by the horizontal divergence of the velocity. Regions of horizontal velocity convergence appear as hydrodynamical sinks for kinetic energy, in addition to frictional effects. It is found that kinetic energy

may be transferred through advection and through work done by pressure forces. It appears that diverging anticyclones are of primary importance in providing kinetic energy for the general circulation. A.

551.513 : 533.6.011.4

On the eddy stress and viscosity in air currents. *See Abstr.* 3819

551.515

4315. The growth of meteorological disturbances. Bondi, H. *Proc. Camb. Phil. Soc.*, **45** (*Pt I*) 92–8 (1949).—The theory of the small motions of a gas, slightly disturbed from a position of equilibrium under the influence of gravity, is developed. It is shown that there is a sharp distinction between slow large-scale (meteorological) and rapidly varying small-scale (acoustical) phenomena. The time scale of meteorological phenomena is derived. Heat conduction and viscosity set a lower limit to the dimensions of such disturbances. If the lapse rate exceeds the adiabatic lapse rate, disturbances will grow from minute to appreciable intensities in a few hours, if their diameter > 500 m, and they will spread vertically more than horizontally. L. S. G.

551.515.4

4316. A suggested mechanism for the generation of thunderstorm electricity. Workman, E. J. and Reynolds, S. E. Letter in *Phys. Rev.*, **74**, 709 (*Sept.* 15, 1948).—Preliminary tests on the potentials developed between the liquid and solid phases of water during a rapid freezing process indicate that contact potentials cannot be advanced as an explanation of the results obtained. Freezing of water in an earthed metal cup produces a potential difference as soon as a thin film of ice separates the water from the cup. The initial polarity is found to depend on the resistivity of the water, a reversal of polarity being sometimes observed as freezing approaches completion. Test results obtained on water drops impinging on cold ice are suggested to satisfy the requirements for the initial electrification in thunder clouds. R. H. G.

551.521.12 : 535.247

Radiation measurements in South Finland with bioclimatic ultraviolet dosimeter. *See Abstr.* 3856

551.54

4317. Wave structure of singularities in weather departures. Flohn, H. Letter in *Naturwiss.*, **34** (*No.* 8) 249–50 (1947) *In German.*—Pressure oscillations at Frankfurt-on-Main have been examined for the periods 1857–92 and 1893–1939. For both series and for the whole period max. amplitudes occur for wavelengths of 73·05, 33·2, 30·4 and 6·6 days. For the whole series the amplitude is 0·3–0·4 mb and for the partial series 0·6 mb > for the semidiurnal or diurnal pressure wave and it is confirmed by the Schuster criterion. The extreme value for the 4 oscillations occurs on December 16–17. It is concluded that the singularities in weather departures are explained as collective free oscillations of the stratospheric circumpolar vortex which bears a simple relation to the length of the year; they are produced in the ozone layer in an approximately sharp periodic repetition by the yearly change of solar radiation in the u.v. R. S. R.

551.54

4318. A new tendency equation and its application to the analysis of surface pressure changes. Godson, W. L. *J. Met.*, **5**, 227–35 (*Oct.*, 1948).—After referring to 3 previously derived pressure-tendency equations the author proceeds to derive a new type of "isobaric" tendency equation. The physical significance of the various terms in the equation is considered in detail. Application is then made of the equation in a study of orographically and thermally induced pressure systems, both as regards development and variation in intensity. The behaviour of extra-tropical cyclones is examined in the light of both the classical and the "isobaric" tendency equations. From his analysis the author concludes that deepening occurs when one or more of the following conditions are met: (*a*) a strong warm-air advection in the lower stratosphere, (*b*) a low level of non-divergence, (*c*) potentially unstable warm-sector air. An example of computation in terms of the "isobaric" tendency equation is given. A. E. M. G.

551.573

4319. A method of estimation of the thickness of the "laminar" layer above an evaporating water surface. Ramdas, L. A. and Raman, P. K. *Proc. Indian Acad. Sci. A*, **23**, 127–33 (*March*, 1946).—Under isothermal conditions of the water layer the heat required for evaporation comes by molecular conduction across the laminar layer, kdT/dZ, and by exchange of radiation with the surroundings. Values of k, obtained from estimates of dT/dZ using increasing height intervals between the surface and the next level of reference, when plotted against the corresponding values of ΔZ fall on a straight line. The thickness of the laminar layer is given by the values of ΔZ where the vertical line at k, the molecular conductivity, cuts the curves. W. R. A.

551.576

4320. A thermodynamic analysis of cumulus convection. Austin, J. M. and Fleisher, A. *J. Met.*, **5**, 240–3 (*Oct.*, 1948).—A formula giving the total mass of liquid water in a cumulus cloud for different lapse rates in the cloud and different mixing regimes of the environment air into the rising cloud air, is obtained. A discussion of it for different lapse rates of temp. and relative humidities of the environment follows. It seems probable that the ideal conditions for the persistence of a cumulus cloud are a high liquid-water content and large horizontal extent. A steep lapse rate appears to be desirable for the development of upwards accelerations. It is not possible to satisfy all 3 conditions simultaneously; for example, a condition which gives rise to high liquid-water content does not appear to favour the development of vertical accelerations. Therefore it should not be expected that a steep lapse rate is necessarily the most favourable condition for cumulus growth. M. D.

551.576

4321. Reflection, absorption, and transmission of insolation by stratus cloud. Neiburger, M. *J. Met.*, **6**, 98–104 (*April*, 1949).—Using Eppley pyrheliometers mounted on a blimp, observations were made of the upward and downward flux of short-wave radiation

above, in and below coastal stratus throughout the summer of 1945. These observations are summarized and evaluated in terms of the percentage of the incident radiation reflected, absorbed and transmitted, as a function of cloud thickness. The simplified radiative transfer equations, in which the radiation is considered to be composed of upward and downward isotropic currents, are solved for general distributions of drop size and liquid-water content, and applied to the distributions found in coastal stratus. The theoretical variation with cloud thickness differs from the observed. This is taken to indicate that the simplied theory is an inadequate description because the radiation is not isotropic. A.

551.576

4322. On the nature and size of particles in haze, fog, and stratus of the Los Angeles region. Neiburger, M. and Wurtele, M. G. *Chem. Rev.*, **44**, 321–35 (*April*, 1949).

551.576

4323. The growth of cloud drops in uniformly cooled air. Howell, W. E. *J. Met.*, **6**, 134–49 (*April*, 1949).—Three integrations of drop growth under simulated natural conditions are described and compared with data for natural clouds, leading to the following conclusions: The computed drop-size spectra agree with observation regarding the relatively uniform clouds most frequently observed. Convergence and mixing of fine-grained turbulence are suggested as influences broadening the distribution in the less uniform clouds. Even for the latter, the computed spectra agree with observation on the shape of the spectrum curve. It is not clear what conditions of cooling most favour a broad spectrum. The computed mean drop sizes agree very well with observation, indicating that growth by collision is not ordinarily significant in uniform clouds. The concentration of drops is determined primarily by the rate of cooling during the initial stage of condensation. It depends, as a rule, only slightly on the concentration of condensation nuclei. With continued uniform cooling, the drop concentration diminishes slightly toward a fixed constant value. It can be increased, once the cloud has formed, only through a great increase in the rate of cooling. Supersaturation during cloud formation ordinarily reaches about 0·1% and can surpass 1% only under extreme circumstances. Subsaturations in descending air currents have the same order of magnitude. Observations of lower relative humidities in clouds, if real, must indicate clear spaces. Operation of the equation of growth on nuclei of modal sizes proposed by Dessens cannot explain the modal drop sizes reported by Köhler. A.

551.578.1

4324. Production of rain by a chain reaction in cumulus clouds at temperatures above freezing. Langmuir, I. *J. Met.*, **5**, 175–92 (*Oct.*, 1948).—Using the Bergeron–Findeisen theory for growth of drops by coalescence with cloud droplets a quantitative theory is developed for the efficiency of the accretion process considering the trajectories of the small droplets moving near the surface of the larger falling drop. It is considered that rain from clouds below the freezing level or after seeding with dry ice arises from a chain reaction in which a drop wi good collection efficiency falls and grows to break-u size and the numerous smaller drops go through th same process and break at a level not lower than th where formed. The critical conditions to mainta the chain reaction involve lower limits for updra velocity, thickness and water content of clou diameters of cloud droplets and of the fragmen formed at break-up. This theory is applied to ra formed by seeding clouds from above with dry ic The development of self-propagating storms unstable air masses by this process is discussed.

R. S.

551.578

4325. Artificial stimulation of rain. King, J. A Halliday, E. C., Hewitt, F. J. and Kingwill, D. C Letter in *Nature, Lond.*, **162**, 921 (*Dec.* 11, 1948).— Varying amounts of dry ice were released either insi or 200–400 ft above developing cumulus clouds incipient thunderstorms on days when fairly nume ous thunderstorms were expected. Photograph records were obtained on a radar screen. A temperatures ranged 7°–29°F. No conclusions cou be reached regarding the varying amounts of ic Echoes were more consistent at the lower temp. N conclusion could be drawn as to whether the i increased the duration or amount of rain whic would have occurred naturally. R. S.

551.578.1 : 532.6

Physical properties of freely falling raindrop *See Abstr.* 3800

551.578.1 : 621.396.9

4326. Rain intensities by radar. Wexler, *J. Met.*, **5**, 171–3 (*Aug.*, 1948).—Assuming raindr diameters $\ll$ the radar wavelength, the pow reflected from the target and measured by receiv is $\propto \Sigma N D^6 \delta D \equiv Z$, where N is the number of rai drops of diameter D distributed in diameter interv δD in a unit volume of space. The basic empiric equation is $Z = C \,.\, R^n$, with Z in $mm^6 \,.\, m^{-3}$ and the rain intensity, in $mm \,.\, hr^{-1}$; C and n are constan with values of $\sim$ 320 for C and 1·44–1·72 for Different observations and computations regardin drop-size diameter and distribution are discussed an critically compared. A.

551.578

4327. Distribution of ice-particle nuclei in the fre atmosphere. Palmer, H. P. Letter in *Nature, Lond* **162**, 568 (*Oct.* 9, 1948).—Measurements of th threshold temp. were made during 4 flights at 2 or levels from Farnborough with an apparatus simila to that of Cwilong. The clean air threshold wa found in all measurements above the temp. inversio stratus cloud or lowest haze top, while below, valu of −33°C to −35°C were found. The greatest heig with the threshold above −41°C was 8 000 ft an the lowest for clean air threshold was 6 000 ft. The results for winter and spring suggest that nucl active at −32°C are present only in air recently contact with the surface. R. S.

551.578.4 : 536.421.4

4328. Nucleation of supercooled water clouds silver iodide smokes. Vonnegut, B. *Chem. Re* **44**, 277–89 (*April*, 1949).—Measurements have bee

carried out on the nucleation of supercooled water clouds by AgI smokes, produced by spraying a solution of AgI into a hydrogen flame. The particles of the smokes were found by electron microscope examination to range in dia. from 30 Å to 1 400 Å. The number of ice crystals produced per gram of AgI was determined as a function of the temp. of the supercooled cloud and the rate of introduction of AgI into the flame. Yields of ice nuclei of as high as 10^{16} per gram of AgI were obtained when the supercooled cloud was at −20°C. At −10°C the same smoke produced only $10^{12 \cdot 7}$ ice crystals per gram. It has been found that AgI particles do not react immediately to form ice crystals when they are put into a supercooled cloud. Ice crystals were found to be still forming at a measurable rate 50 min after a AgI smoke was introduced into a supercooled cloud. It is believed that fewer ice crystals are produced at higher temps. than at lower temps., because the AgI particles react more slowly to form ice crystals and most of them precipitate on the walls of the cold chamber before they have time to react. According to this interpretation of the results, the rate of reaction at −13°C is 30 or 40 times that at −10°C. A.

551.578.4 : 536.421.48

4329. The formation of ice crystals in the laboratory and the atmosphere. SCHAEFER, V. J. *Chem. Rev.*, **44**, 291–320 (*April*, 1949).—Some properties of natural snow particles in the free atmosphere and their electrical characteristics observed in snowstorms are given. A method for classifying snow particles is listed and the typical varieties illustrated by photomicrographs. Methods of preparing plastic replicas of snow crystals and of snow on the ground are described. Techniques for detecting sublimation nuclei in the free atmosphere are given, involving the use of a cold chamber and supercooled films supported on rings or on thin plastic films. A description is given of the technique used in simulating natural clouds in the laboratory, and the basic procedures which should be followed are listed. A brief description of the role that certain types of dust particles play in serving as sublimation nuclei is mentioned and the results observed with a considerable number of typical samples and their effectiveness at various temperatures. The effect on the crystal habit of ice produced by the blocking action of adsorbed surface-active polar molecules is shown. The latter part of the paper describes briefly some of the aspects of the cloud modification studies initiated by the author in 1946. A few of the observed results are mentioned, as well as the relationships which are believed to exist in unstable clouds. A.

551.578.4 : 536.423

Condensation in water vapour below 0°C. *See Abstr.* 3930

551.582

4330. The climate of the Arctic as viewed by the explorer and the meteorologist. HOBBS, W. H. *Science*, **108**, 193–201 (*Aug.* 27, 1948).—Two areas are dealt with, the Central Arctic basin and Greenland. In a review of explorers' reports it is claimed that the former is an area of light winds and uniform pressure. It is claimed for Greenland that it is continuously covered by a glacial anticyclone with winds outflowing from the centre, and that all explorers' reports and those from fixed stations confirm the view. This regime extends to 3 000 m at the coast and to 400 m at the central plateau. The heavy frequent precipitation at the centre is said to be due to the Ci clouds. A few opposed views that depressions travel across Greenland, claimed to represent meteorologists, are stated to be impossible. R. S. R.

551.593.12

4331. Scintillation of the radiation of terrestrial sources of light and its variation in day-time. LIEDENTOPF, H. AND WISSHAK. *Optik*, **3**, 430–43 (*July–Aug.*, 1948) *In German.*—The disturbances in the air near the ground produce modulations of intensity of the light from distant sources which may be measured by a c.r.o. The frequencies are mainly in the 1–30 c/s range and increase with the strength of modulation which may reach ~ 100%. The daily curve of the degree of modulation in bright weather shows 2 minima, shortly after sunrise, and before sunset, a steep maximum at noon, and a flat evening maximum. A similar curve is shown by the exchange coefficient investigated by H. Lettau. The scintillation method, though, does not measure exchange itself, but the variations of the refractive index of the air connected with the former. A.

551.593.55 : 525.75

4332. On the excitation of bands of N_2^+ during twilight. DUFAY, M. *C.R. Acad. Sci., Paris*, **227**, 777–9 (*Oct.* 18, 1948) *In French.*—Systematic observations, 1946–48, indicate: (i) twilight emission of the bands is a diurnal phenomenon; (ii) night-to-night fluctuations of intensity are confirmed; (iii) over the entire period no significant correlation with magnetic activity is evident; (iv) band intensity is at a max. for levels in the sunlit atmosphere ~ 90–100 km, i.e. within the ionospheric *E* region. Of the two modes of excitation possible—optical resonance, or direct ionization—results tend to support the former. D. R. B.

551.593.55 : 535.33

4333. Emission spectra of the upper atmosphere at twilight. ELVEY, C. T. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 16–21 (1948).—Systematic measures of the principal emissions from the twilight sky have confirmed: (i) enhancement of the O I line, 6 300 Å, persisting several hr after evening, and before morning twilight; residual intensity decreases rapidly 0–1·5 hr after sunset, then less rapidly through night. The negative band of N, 3 914 Å, shows similar twilight strengthening; (ii) the Na I doublet, 5 893 Å, and the unidentified line at 6 560 Å show sudden enhancement in twilight. At 5 893 Å the intensity distribution indicates a concentration of Na atoms ~ 20–120 km; (iii) the O I line, 5 577 Å, shows little twilight strengthening, and remains fairly constant throughout the night. D. R. B.

551.593.9

4334. Theoretical considerations regarding the night sky emission. BATES, D. R. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 21–33 (1948).—

Current theories regarding the origin of the upper atmosphere emission are concerned with either the release of potential energy, or the entry of extra-terrestrial particles. Both aspects are discussed critically in the light of current knowledge, and it is concluded that neither theory alone can satisfy observation completely. A useful bibliography is appended. D. R. B.

551.593.9

4335. Altitude of the layer emitting the night-sky light. VASSY, A. AND VASSY, E. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 53–9 (1948).—From photoelectric measures of intensity of the 5 577 Å, 5 893 Å and 6 300–6 580 Å emission features at different zenith distances it is concluded that: (i) no single layer is responsible for the n.s. light; (ii) the heights of emission of the different radiations are not distributed uniformly around the earth; (iii) the green radiation most probably originates from one layer at 1 000 km (int. 1) and a second layer at 75–100 km (int. 0·5); (iv) the red radiation is ascribed to one layer at 750 km (int. 1) and a second layer at 100 km (int. 0·1). Agreement with observation is not wholly satisfactory. D. R. B.

551.593.9

4336. Temporal and spatial variations in night-sky light. VASSY, A. AND VASSY, E. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 60–1 (1948).

551.593.9

4337. Provisional determination of the height of the luminous layers of the atmosphere at night. DUFAY, J. AND TCHENG, M.-L. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 62–9 (1948) *In French.*—Using photographic spectrophotometry intensities of the n.s. emission spectrum at 5 577 Å, 5 893 Å and 6 300 Å have been determined for zenith distances 70° and 20°. From these measures effective heights for each radiation are computed with an uncertainty of ± 30 km after correcting for absorption and scattering. The results are at variance with the hypothesis of Vassy [Abstr. 4335 (1949)]. D. R. B.

551.593.9

4338. Use of Savart–Lyot polariscope in the study of the nocturnal and twilight radiation. BRICARD, J. AND KASTLER, A. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 70–2 (1948).—A useful description of the various techniques employed in monochromatic photographic interferometry, and their application to the study of the 3 principal radiations of late twilight and the night sky, viz. 5 577 Å, 5 890–96 Å and 6 300–64 Å. D. R. B.

551.593.9

4339. Measurements of the brightness of the night sky. GRANDMONTAGNE, R. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" 1947) (*Phys. Soc., Lond.*, 72–6 (1948) *In French.*—A critical discussion of the difficulties met with in photometering the light of the night sky which result from the complexity of its spectral distribution. An ideal comparison source is non-existent, nor is possible to assign a colour temp. over the entire ran of spectrum studied. D. R.

551.593

4340. Measurements of the brightness of the nig sky. HULBURT, E. O. *Rep. Conf. Gassiot Comr Roy. Soc.* "*Emission spectra of night sky and aurorae* (1947) *Phys. Soc., Lond.*, 76–82 (1948).—A summa of measurements to determine atmospheric tran mission, the brightness of the twilight sky, the zodiac light, and the light of the night sky made by the joi eclipse expedition of the National Geographic Socie and the U.S. Army Air Forces to Brazil, April–Ma 1947. D. R.

551.593

4341. Comparison of the Na and N_2^+ flashes twilight and dawn. SWINGS, P. AND NICOLET, M *Astrophys. J.*, **109**, 327–30 (*March*, 1949).—A di cussion of the results from a series of good spectr grams, taken at morning or evening twilight, lea to the following important conclusions: (1) t intensities of both emissions (Na and N_2^+) increa with decreasing solar depression, the limit of measur ment being set by the continuum of scattered su light; (2) for the same effective height of emission, t relative intensities of Na and N^+ vary markedly ov short intervals of time, and over long interval seasonal effects are present; (3) the intensity gradie of N_2^+ is sensibly constant, whereas that of Na vari considerably; (4) under normal (non-auroral) co ditions, N_2^+ has the same intensity at dawn as dusk, but Na is stronger at dawn; (5) N_2^+ emissio has been observed up to ~ 130 km, whereas n twilight Na is detectable above ~ 100 km. D. R.

551.593.9 : 535.3

4342. The emission spectra of the night sky an aurorae. CHAPMAN, S. *Rep. Conf. Gassiot Comm Roy. Soc.* "*Emission spectra of night sky and aurorae* (1947) *Phys. Soc., Lond.*, 1–3 (1948).

551.593.9 : 535.3

4343. The light of the night sky: description spectra and identification of observed radiation DÉJARDIN, G. *Rep. Conf. Gassiot Comm. Roy. So* "*Emission spectra of night sky and aurorae*" (194 *Phys. Soc., Lond.*, 3–8 (1948) *In French.*—The mai features of the n.s. emission spectrum in the u.v visible and i.r. regions are summarized, and a tab of positions, relative strengths and identifications 81 lines or bands in the interval 3 000 Å–5 200 Å included. D. R.

551.593.9 : 535.3

4344. Presence in the spectrum of the night sky of new system of bands still unidentified. BARBIER, D *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectr of night sky and aurorae*" (1947) *Phys. Soc., Lond* 8–12 (1948) *In French.*—A regular band syste appearing in the interval 3 236 Å–5 160 Å, as y unidentified in laboratory spectra, is tentative ascribed to CO. D. R.

551.593.9 : 535.3

4345. The spectrum of the night sky: some problem in the identifications. PEARSE, R. W. B. *Rep. Con*

assiot Comm. Roy. Soc. "*Emission spectra of night sy and aurorae*" (1947) *Phys. Soc., Lond.*, 12–15 948).

551.593.9 : 535.33

346. Variations in the intensity of emission lines om the night sky. DUFAY, J. *Rep. Conf. Gassiot omm. Roy. Soc.* "*Emission spectra of night sky and urorae*" (1947) *Phys. Soc., Lond.*, 51–3 (1948) *In rench.*—The results of a systematic study of intensity ariations shown by the principal n.s. emission lines, 577 Å, 5 893 Å, 6 300 Å, from Oct., 1940, to Jan., 944, are summarized. Diurnal, annual and secular anges are found and are discussed in relation to agnetic and solar activity. D. R. B.

551.593.9 : 537.591

347. A possible contribution to the light of the night y from the Cerenkov radiation emitted by cosmic rays. LACKETT, P. M. S. *Rep. Conf. Gassiot Comm. Roy. oc.* "*Emission spectra of night sky and aurorae*" 947) *Phys. Soc., Lond.*, 34–5 (1948).—It is sug- ested that the fast electron component of soft cosmic ays will excite a weak visible radiation on passage rough the high atmosphere and thus set a lower mit to the brightness of the night sky. Since this erenkov radiation is estimated to be $\sim 10^{-4}$ of the otal light, it remains undetectable by existing ethods. D. R. B.

551.593.9 : 551.510.535

348. Deductions regarding the state of the high tmosphere. NICOLET, M. *Rep. Conf. Gassiot Comm. oy. Soc.* "*Emission spectra of night sky and aurorae*" 947) *Phys. Soc., Lond.*, 36–48 (1948).—Spatial and mporal variations of the various emission pheno- ena at twilight and at night are reviewed, and the llowing conclusions are drawn: (i) solar radiation responsible for all upper atmosphere ionization. bservations do not exclude ionization by extra- rrestrial particles, although corpuscular theories e unconvincing; (ii) production of n.s. emission is ormally by recombination processes; (iii) spatial ariations of the sky light are related to ionospheric ructure and to certain disturbing effects (meteors); v) correlations exist between brightness of n.s. light nd magnetic activity; (v) atmospheric equilibrium is estroyed during ionospheric and magnetic storms ith auroral activity; (vi) correlation between n.s. ght and electron density of *F* layer is slight due to on-proportionality of electron density to electron ntent of whole layer. D. R. B.

551.594

349. Extra-terrestrial influences. HOYLE, F. *ep. Conf. Gassiot Comm. Roy. Soc.* "*Emission ectra of night sky and aurorae*" (1947) *Phys. Soc., ond.*, 138–9 (1948).

551.594.5

350. The excitation in the aurora. WURM, K. *Vimmelswelt*, **55** (*Nos* 3–4) 74–5 (1948) *In German.*—he composition of the aurora spectrum and its ariation with height confirm the author's view that e excitation is exclusively due to collisions of the imary solar corpuscles with the atoms and mole- ules of the atmosphere, and that no secondary ocesses (chemiluminescence, etc.) are involved. A. B.

551.594.5 : 535.33

4351. Spectra of hydrogen and helium in the Aurora Borealis. BERNARD, R. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 93–7 (1948) *In French.*—Balmer emission at 6 562 Å, 4 861 Å, 4 341 Å and 4 102 Å, first detected by Vegard (1941), has been confirmed. The presence of lines due to He I and He II also has been established, notably a strong radiation at 4 685 Å enhanced in spectra of high-altitude rays. D. R. B.

551.594.5

4352. The aurora. BATES, D. R., MASSEY, H. S. W. AND PEARSE, R. W. B. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 97–105 (1948).—A critical review of observational material and current theory (Vegard, 1939; Mitra and Ghosh, 1946). The need for more quantitative data is stressed. D. R. B.

551.594.5

4353. The laboratory production of auroral after-glows. KAPLAN, J. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 118–20 (1948).

551.594.5

4354. Theories of aurorae. CHAPMAN, S. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 120–32 (1948).—Various theoretical treatments of the origin and nature of auroral activity are surveyed critically. It is emphasized that existing theories can explain only the main experimental facts: a comprehensive treatment has yet to be formulated. D. R. B.

551.594.5

4355. On the theory of the aurora. ALFVÉN, H. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 132–7 (1948).—An adequate theory of aurorae based on extra-terrestrial particle interaction must take into account the electric field associated with the incoming ionized stream. The effects of such fields are discussed, and it is concluded that auroral phenomena are induced by gaseous discharges in the electric field, the current flowing from space to ionosphere, a result supported by observation of "flaming" aurorae. D. R. B.

551.594.5 : 535.333

4356. Wavelength of the line N I (^4S–^2P) of atomic nitrogen in the spectrum of Aurora Borealis. BERNARD, R. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 91–2 (1948) *In French.*

551.594.5 : 535.33

4357. New aspects of the problem of interpreting auroral radiations. NICOLET, M. *Rep. Conf. Gassiot Comm. Roy. Soc.* "*Emission spectra of night sky and aurorae*" (1947) *Phys. Soc., Lond.*, 105–17 (1948) *In French.*—The band systems present in the auroral spectrum are discussed with special reference to the possible presence of weak bands due to NO previously attributed by Vegard (1941) to O I, O II, O III, N I, N II, N III. Tables of laboratory and auroral wavelengths are given. D. R. B.

553.495

4358. Some mechanisms for the fixation of uranium in certain sediments. FREDERICKSON, A. F. *Science*, **108**, 184–5 (*Aug.* 20, 1948).—Spectrographic analysis of a drill core of bauxite suggested the presence of U, which was confirmed by tests with a β counter. It suggested that the wide distribution of U is due to tendency to form large UO_2^{++} ions, and that, particular, the U found in shales may be in the fo of adsorbed ions and not of discrete minerals. C. B

BIOLOGY 57/59

574 : 519

4359. Development of mathematical biophysics in U.S.A. from 1939 to 1945 inclusive. RASHEVSKY, N. *Rel. Pont. Acad. Sci.* (*Auct. Sci. Temp. Belli*) (*No.* 14) 3–28 (1946) *In English.*—24 pp. bibliography.

578.088 : 545.824

Use of X-ray and electron apparatus in biochemical chromatography. *See Abstr.* 4250

578.088.5

4360. Increase in the rate of growth of tissue cultures irradiated by microwaves (wavelength 21 cm). DE SÉGUIN, L., LASFARGUES, E. AND PELLETIER, M. *C.R. Acad. Sci., Paris*, **227**, 783–5 (*Oct.* 18, 1948) *In French.*—Cultures of chick embryo heart and guinea pig spleen were exposed to 21 cm electromagnetic radiation (200 W) for 1–3 min within an hour of preparation. The rate of growth (from area and weight) was greater for irradiated than for control preparations, and > for those given comparative heat treatment unless the temps. produced were lethal. E. E. C.

578.088.5 : 537.542

4361. A method of estimating the time at which a counting rate changes, using a G.M. counter. OSBORN, S. B. AND WRIGHT, H. P. *Brit. J. Radiol.*, **22**, 110–16 (*Feb.*, 1949).—The rate of blood flow from foot to groin is measured by injecting Na^{24} and observing time at which radiation at groin increases. A recorder plotting total number of counts against time shows a clear discontinuity of slope at the time the active blood reaches the counter. Details of apparatus used are given. F. T. F.

578.088.5 : 541.141

Hydrogen peroxide and the indirect effect of ionizing radiations. *See Abstr.* 4220

595

4362. The sounds of disease-carrying mosquitoes. OFFENHAUSER, W. H., JR. AND KAHN, M. C. *J. Acoust. Soc. Amer.*, **21**, 259–63 (*May*, 1949).

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612.84

4363. The influence of the temperature of the eye on its spectral response curve. DE VRIES, H. *Experientia*, **4** (*No.* 9) 357–8 (1948) *In German.*—Experiments were conducted to test the idea that the small long-wave light quanta could only decompose a molecule of the photochemical substances if this molecule had already a sufficient thermal energy. The sensitivity for long wavelengths should thus be higher at high tem The sensitivity for the wavelengths of 660 mμ a 730 mμ were compared with each other and experimental results were close to the lines wh were predicted by the theory.

612

4364. The visibility of moving objects. LUDVIGH, *Science*, **108**, 63–4 (*July* 16, 1948).—If a disc travelling across the field of view of an observ there is a maximum speed at which the object recognizable as a disc. The author establishes empirical formula connecting this speed with size of the disc. J. W. T.

612

4365. The structure of the middle ear and the hear of one's own voice by bone conduction. V. BÉKÉSY, *J. Acoust. Soc. Amer.*, **21**, 217–32 (*May*, 1949).

612

4366. The vibration of the cochlear partition anatomical preparations and in models of the inner e V. BÉKÉSY, G. *J. Acoust. Soc. Amer.*, **21**, 233– (*May*, 1949).

612

4367. On the resonance curve and the decay per at various points on the cochlear partition. V. BÉKÉ G. *J. Acoust. Soc. Amer.*, **21**, 245–54 (*May*, 1949).

612.85 : 534.

The effect of white noise on the loudness of spee *See Abstr.* 3851

614.8 : 539.

A hood for work with radioactive isotopes. *S Abstr.* 4125

615.8

4368. An investigation into some factors affecti X-ray dose distribution and its measurement. OLIV R. AND KEMP, L. A. W. *Brit. J. Radiol.*, **22**, 33– (*Jan.*, 1949).—Measurements in a water phanto show smaller depth doses than the commo accepted values, and greater surface back scatt The deviations are attributed to the use of wax in t earlier measurements, and the effects are most mark on large fields. The influence of ionization chamb size and shadow of stem are studied, as well as t effect of closed ended applicators. F. T.

615.8

4369. Report on the installation of a ten gram teleradium unit. MARTIN, J. H., TULLEY, T. J. A HARRISS, E. B. *Brit. J. Radiol.*, **22**, 44–8 (*Ja* 1949).—The conversion of a 5 to a 10 gm unit a the measurement of radiation with a remote-controll ionization chamber and d.c. amplifier are describe Stray radiation round the final unit is shown to rea tolerance level at a distance of about 9 ft. F. T.

615.849

4370. Studies of the absorption and focusing of short electromagnetic waves in electrolytes and biological tissues as basis for the medical application of radiation fields. PÄTZOLD, J. *Wiss. Veröff. a. d. Siemens-Werken*, **19** (*No.* 2) 1–31 (1940) *In German.*—The possibility of concentrating h.f. energy at a depth below the skin in short wave diathermy is investigated by means of dilute solutions having conductivities equal to those of body tissues. The transmitting dipole is immersed in the liquid and various forms of parabolic and ellipsoidal reflector are used. Field strengths are measured with thermocouples and temp. rise with benzene-filled thermometers. Wavelengths used range from 50 to 430 cm. Focusing in the liquid is found to give only about 1% of the gain in free air owing to the high absorption, and the optimum reflector size is shown to be only about 1 (liquid) wavelength. Ceramic-filled reflectors are tried in place of water to reduce losses, but the focusing is much less efficient. Curves are given of radiation distributions in water and body tissues and the practical application to clinical work is discussed briefly. F. T. F.

METALLURGY 669

669

4371. The constitution of the aluminium-rich aluminium–cobalt–copper alloys, with special reference to the role of transitional metals in alloy formation. PFEIL, P. C. L. AND RAYNOR, G. V. *Proc. Roy. Soc. A*, **197**, 321–35 (*June* 22, 1949).

669

4372. The contribution of modern physics to metallurgy. SEITZ, F. *J. Appl. Phys.*, **19**, 973–87 (*Nov.*, 1948).—Describes the results of the modern theory of solids in such fields as those of structure, electrical conduction, metallic cohesion, magnetism and the mechanical properties of metals. H. P. M.

PHOTOGRAPHY 77

771.351 : 535.317.25

The photographic and visual resolving power of lenses. I. Photographic resolving power. *See Abstr.* 3858

771.53

4373. Electron microscope investigations on single stages in the preparation of [photographic] emulsions. ARENS, H. *Z. wiss. Photogr.*, **43** (*Nos* 1–8) 120–38 (1948) *In German.*—Reports a study of the grain-growth in photographic emulsions during the ripening process, by means of the electron microscope. Lippmann grains are used as a starting material. J. T.

771.534.2

4374. Nature of the spectral distribution of the characteristic photosensitivity of silver halide photographic films. BREIDS, I. I. AND GOROKHOVSKY, Y. I. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 5) 633–6 (1949) *In Russian.*

771.535

4375. Contribution to the theory of the latent photographic image. ANDERAU, W. *Experientia*, **4** (*No.* 10) 383 (1948) *In German.*—Unexposed Ag–Br without gelatine is blackened by the usual developing solutions, whereas Ag–Br in gelatine suspensions becomes only very slowly blackened by developing solutions. This stability of unexposed Ag–Br emulsions with regard to developing agents may be caused by the formation of a complex of Ag–Br with gelatine. It is believed that complex compounds of bivalent Ag form the essential and active compound of the latent image. R. H. H.

778.3

4376. Tracks of low-ionizing particles in photographic emulsions. SPENCE, J., CASTLE, J. AND WEBB, J. H. Letter in *Phys. Rev.*, **74**, 704–5 (*Sept.* 15, 1948).—Photographic emulsions for the recording of particles of low ionizing power have been considerably improved recently. The sensitivity is increased to a point where the plate will register a particle of twice the energy loss rate of the minimum for any charged particle. The minimum of the energy loss curve in air is at 0·0022 MeV/cm and with available Kodak emulsions an energy loss of 0·005 MeV/cm (corresponding to 100 keV electrons) can be recorded. R. H. H.

778.3

4377. Development of thick emulsions by a two-bath method. BLAU, M. AND DE FELICE, J. A. Letter in *Phys. Rev.*, **74**, 1198 (*Nov.* 1, 1948).—Uniform development throughout the thickness of a 200 μ thick nuclear emulsion has been obtained by the use of a two-bath development method. In the first bath, containing no alkali, the developer penetrates into the emulsion. In the second bath, which contains all the constituents of an ordinary developer (plus alkali), the actual development takes place. The temps. of the solutions were all kept constant. R. H. H.

778.3 : 537.112

Electron range/energy relations in nuclear plates. *See Abstr.* 3963

778.33

4378. Quantitative autoradiography. ZUBER, K. *Helv. Phys. Acta*, **21** (*No.* 5) 365–74 (1948) *In German.*—An investigation has been carried out to see whether quantitative results can be obtained from autoradiographs. It is shown that an answer can be obtained from a substance emitting a reasonably small number of β-rays per sec and of not too short a $\frac{1}{2}$-life. A test with Au^{198} yields a $\frac{1}{2}$-life of $2{\cdot}77 \pm 0{\cdot}06$ d. The absorption coefficient for the β-rays from Au^{198} was found to be 21·1 cm/gm. G. O. B.

778.33

4379. The clinical application of autoradiography using short-lived artificial radioactive isotopes. MÜLLER, J. H. *Experientia*, **4** (*No.* 10) 406 (1948) *In German.*—Large-scale autoradiographs, made by placing a film on the skin of a patient following injection of a radioisotope, are described. A dose of the order of 100 mc is required, and the technique has been applied to carcinomatous patients to outline the blood vessels of skin and subcutaneous tissue.

F. T. F.

778.33 : 531.717

Method for measuring the thickness of thin coating films by means of X-ray reflex photography. *See Abstr.* 3780

778.37

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